Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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EDITORIAL

THE 1924 ROAD SHOW

The "Road Show" is of such great importance to everybody in any way connected with, or interested in, road and street work, that we are devoting several pages of this issue to an announcement of the 1924 Show, the convention program, and the plans, accommodations, etc., which those responsible for the success of the enterprise have provided. This is the one event of the year the worker in the highway field can ill afford to miss.

There are many reasons why thousands of men attend these shows year after year. More information can be acquired, with reference to materials and machinery, by visiting the exhibits at the show than in any other way, and at a minimum expenditure of time and money. To many the greatest appeal of the show is the opportunity it provides to meet old friends we seldom, if ever, see elsewhere, and it enables us to meet face to face those with whom we have corresponded but have never seen. This opportunity to meet people would of itself justify all the work and expense of holding these shows. Those who want to meet the leading highway engineers, contractors and manufacturers should attend the 1924 Road Show.

THE SUPERLATIVE IMPORTANCE OF SOUND HIGHWAY FINANCING

The amount of attention now being devoted to the study of sound highway financing shows that the superlative importance of this subject is appreciated by many. The term "highway" is here intended to have its usual legal meaning which includes city streets and alleys as well as state, county and township roads. The expenditures for highway improvement are now so vast that great injustices may be done in distributing the cost unless the problem is carefully studied and honestly solved.

The subject is very difficult and few, if any, are ready to say that they know just how the problem should be solved. But it is not doubted that equitable solutions will be found as a result of much discussion. Several articles in this issue deal with this subject and more attention will be devoted to it in the future. It is hoped that engineers will apply their trained minds to this problem because of its major importance.

It is comparatively easy to point out some theories that are sound and some that are unsound. The soundness of the gasoline tax, as a road service tax, with proper exemptions for gasoline used in industry and agriculture, has been expounded in these columns on several occasions. This is now regarded as the fairest of all highway taxes, provided only that the proceeds of such taxes are devoted exclusively to highway purposes. There are now 36 states with gasoline tax laws in operation and the measure is popular. About the only remaining opposition comes from motor club officials, who, in the interest of membership renewal and extension, are interested in keeping down the apparent first costs of operating a motor vehicle while disregarding ultimate total costs. Such officials have been able to obstruct the will of the majority of informed people in some cases but such victories are likely to prove short-lived. The people are not "pikers"; they are willing to pay for what they get and the favorable attitude of the great majority of the people toward the gas tax is only one proof of this statement. Gasoline tax legislation is most encouraging to those who favor sound and sane taxation measures. Of course it is indefensible to tax the motorist's gasoline for school, general, or any other purpose except for highway purposes.

A good example of unsound doctrine is the argument that taxes on property alone should be levied to pay for highway construction while taxes on the road user should be only enough to pay for the maintenance of roads. This is an absurd argument; it is easily reduced to an absurdity. In effect it means that the user should pay more for the use of a bad road than for the use of a good road. Since maintenance costs are higher on bad roads than on good ones this amazing doctrine means simply this: the better the road the less the charge for using it. It is astonishing that many men who have achieved affluence and a degree of fame in the automotive world

are seriously advocating that this fallacious form of financing be adopted. Such men in opposing the gasoline tax and in promoting this ludicrous theory of making property pay for construction and the user for maintenance only have surrendered the leadership in this great study. It is distinctly discreditable that their reasoning has been so unsound or so unfair, as the case may be. It is because they are fit to play a more worthy role that they are here so severely criticised. It will do the automotive industry no good to advance insincere or unsound theories in discussing this subject, for faults will quickly be detected and pointed out by men of intelligence in other lines of work than the manufacture and sale of motor cars.

There has, perhaps, been too great a tendency toward generalization in discussing highway finance; not enough attention has been devoted to limiting legal and other local conditions. For example, some say that bond issues should be made to pay the cost of construction of state highways. This statement is often made without any reservations whatever, despite the fact that many important states, Indiana and Wisconsin, for example, cannot bond without first amending the state constitution. It is very doubtful if the Indiana constitution could be amended for this or any other purpose at this time as the residents of this State are rather out of sorts with certain recent amendments to the federal constitution and want to leave our fundamental laws alone for the present.

Even when it is now permissible to bond a state for highway purposes there is a very serious question as to whether or not the cost should be shifted to a later generation by this device. The next generation will have its own problems and it seems unnatural to be shifting the highway liabilities to our children and grandchildren when we are doing all we can in other ways, to make and save assets to leave them. Again, where recourse is had to bonding it is much easier to defend the justice of bonding only to pay for the permanent portion of the road than for the parts that will not outlive the bonds. Rather a good case can be made out for bonding to pay for changes in grade and alignment to save operating costs, for grading and foundation work, and for some bridge work, but it is very difficult to justify, in theory, and as a general proposition, bonding to pay for a wearing surface of compartively short life.

The states of Illinois and Indiana present an instructive contrast in their country road problems. Illinois can bond; Indiana cannot. Ilinois has two types of roads: the highest type of modern highways and the most malevolent mud roads to be found anywhere with the possible exception of Iowa. (An Iowa man recently told the editor that Illinois mud roads have a bottom but that Iowa mud roads are bottomless.) Indiana has an extensive mileage of an intermediate class of roads, namely, gravel and stone roads. Between her modern paved highways and her mud roads Indiana has 30,000 miles of splendid gravel roads reaching every city of any importance in the state. In fact, nearly every highway of any consequence has a good gravelled surface. The extent of these gravel roads may be better appreciated when it is stated that their mileage is six times greater than that of the 7 per cent federal aid system designated for ultimate hard surfacing. Illinois had only mud roads up to a very few years ago. She is now acquiring her primary system at the rate of 1,000 miles a year. After this primary system is finished it will take Illinois many years to construct her secondary system. On the other hand, Indian now has her secondary system and needs only finish her primary system of less than 5,000 miles to have adequate highway development. It will be seen that greater haste is justified in Illinois than in Indiana, in the matter of primary road construction, with a corresponding greater annual expenditure. It may be wise to bond in Illinois, therefore, while the pay-as-you-go plan is clearly right for Indiana. Thus do local conditions influence polices of financing and a dependable financing creed must make due and proper allowance for local conditions.

A subject that is beginning to attract serious study is that of paying for the cost of city pavement reconstruction. This can no longer fairly be charged entirely, or even largely, to abutting property. Then, there is the very knotty question of taxing the motor vehicle for the upkeep of city streets. How shall this be done Shall city and state levy separate taxes or shall the state collect and refund to city and county? If the latter, on what basis shall the refund be made? These are questions requiring much study and their early and proper solution is highly important.

These are the most urgent questions in the whole world of highway affairs. They challenge the best minds of the country.

HOW SHALL WE PAY FOR OUR STREET PAVEMENTS?

Address by John L. Elliott, City Civil Engineer, Indianapolis, Before Second Annual Convention, Allied Motor Commerce (of Ind.)

The type, cost and method of paying for street paving is becoming a more and more important and very intricate problem.

Traffic conditions and requirements are creating more complex situations today in connection with the problems of paying or assessing street improvement costs than ever before and will continue to do so unless some efficient and economical solution is found.

In the beginning of civilization, transportation was not a problem and the early taxpayer was never worried about street or road improvements or assessments. Travel was confined to walking or riding various animals, and roads of those days were for the most part only beaten paths. As desires of man increased, transportation in vehicles increased and with them the necessity for better paths or roads. But even these roads were not expensive and their cost was usually borne by the community.

When the social instinct developed and people congregated in villages and towns, the need for streets or avenues upon which to travel back and forth, in vehicles or otherwise, become obvious. Transportation increased and the old path had to be made into a little better road or street.

The better type of road or street necessarily meant the expenditure of money which in the earlier days, even of this country, was borne by the locality as a whole and sometimes built the same way. With increasing population, villages became towns, towns grew into cities and the necessity for providing better streets gave rise to the question which confronts us today: "How shall the cost be paid?"

The accepted practice in this country, until recent years, has been to assess the cost of street paving in whole or in part directly against the property abutting the improvement. The number of different methods for assessing this cost was almost as great as the number of states and cities affected, but the fundamental principle of making the abutting property owner pay the bill was always present. In Indiana, until a very few years ago, the cost of all street improvement was assessed against the abutting property or the streets intersecting the street being improved. With the advent and growth of motor transportation, came the necessity for more and better paved streets. Engineers and economists began to realize that to assess the cost of all street improvements against the abutting property owner was unfair and unjust.

Heavy hauling and motor transportation added a new factor to the question. Streets must be built better and resurfaced oftener. In the past, it has been common to have streets in use 40 years or more without resurfacing. In fact, contract was awarded by the City of Indianapolis recently to resurface a street that has been in use 34 years. Such wear cannot and is not expected today from ordinary street paving. Should the abutting property owner be made to pay for new streets at conservatively frequent intervals to facilitate the travel of the city at large?

There is no question but what the original improvement is a benefit to the abutting property; in fact, in the great majority of cases it benefits the property much more than it costs. One well known business man of this City has stated that, in his opinion, original street improvements add five times their cost to the value of the abutting property. Resurfacing, however, cannot be said to add a great amount to the value of the abutting property at least not the entire cost. The question then is: "Who shall pay if not the abutting property owner?" Some will say the logical answer is "Those who are benefited."

The benefits of resurfacing a street are widespread. The abutting property owner naturally is benefited to some extent by having a much better street in front of his property. The commercial interests are benefited because deliveries are quickened with less cost for repairs. The pleasure seeker is benefited since he can ride in greater comfort with less repair bills. In fact, the public generally benefits from resurfacing, therefore the conclusion: the public generally should pay the bill.

There is another method of reasoning used on resurfacing which also has a great deal to recommend it. The original street is improved to give access to the property being improved. The owners of this property, however, do not wear out the improvement they have paid for. When the street must be resurfaced, why not make those who have worn out this street pay the cost of resurfacing? The result of this reasoning naturally means a tax on all vehicles using the streets.

There is much to commend and also to condemn in both these theories. It is our opinion that neither taken alone offers the solution of the question: "Who shall pay?"

Increased traffic is adding another cost on street improvements which demands attention. Narrow streets must be made wider and certain streets must be substantially and expensively paved to provide for heavy hauling. When these improvements come as part of the original cost is it fair to assess the entire cost against the abutting property? Manifestly it is not. Some standard of width and paving should be adopted as the equitable improvement assessable against the abutting property and the remainder paid in the same manner as resurfacing.

I believe it to be a self-evident proposition that the best method to collect any assessment or tax is that which causes the least irritation to the taxpayer. With this in mind, I would recommend that the question, "Who shall pay?" be answered as follows:

The cost of the original street improvement of a standard width and type should be paid entirely by the abutting property owners. Any expenditure made necessary by providing a wider or better pavement should be paid by the city from a street improvement and repair fund which shall be a continuing fund, collected in a manner to be described later.

Resurfacing costs should be paid entirely by the city from the above mentioned fund. Charging the entire cost of resurfacing against the city is more economical than assessing a percentage against the abutting property as it places the entire burden of maintenance on the city and is an incentive to better repairs. It also permits the resurfacing of such portions of streets as need resurfacing. Whereas assessing any portion of the cost against the abutting property necessitates the resurfacing of entire sections of streets and from curb to curb.

The fund previously mentioned should also be used for the maintenance and repair of all improved streets and should be provided in part by direct taxation and collected as other taxes and in part by taxes on the users of streets. This tax should be a part of the registration fee collected by the state and should be returned to the city in proportion to the number of automobiles and trucks registered from that city. A certain portion of the gasoline tax collected by the state should be returned to offset the money expended in repairs. All fees collected for permits to cut streets and all money collected for repairing of cuts should also go to this fund. The fund should be a continuing fund from year to year so that any unexpended balance will be available the next year.

The whole question of assessing the cost of street improvements must be viewed with justice and fairness to all concerned. Co-operating between the property owner and the vehicle owner means better streets and and better business.

THE DESIGN AND OPERATION OF SEWAGE PUMPING STATIONS

By C. S. Timanus, of Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo.

While the art of pumping water has been practiced for hundreds of years, the lifting of sewage by mechanical means was little used until comparatively a few years ago. The progress in the design of machinery for handling sewage began with the universal adoption of the water carriage system of sewage disposal, and has since kept pace with the widespread demand for better sanitary conditions.

There has been much discussion of the proper method of pumping sewage. First cost, reliability, economy of operation and sanitary features are the important topics of interest and discussion.

Reliability and Sanitary Features

Reliability is perhaps the most important of these elements, while the sanitary features of a plant rank as a close second. Indeed, the two elements are very intimately related. An unreliable plant may easily become the cause of unsanitary conditions and a nuisance. On the other hand, a plant may be dependable—always capable of handling all the inflowing sewage—but, nevertheless, a nuisance on account of unsanitary receiving wells, trash racks or bar screens.

Cost

Secondary in importance to the reliability and sanitary features of a plant come its first cost and economy of operation. Theoretically, the allowable first cost depends on the economy of operation, and operating economy in turn depends on labor costs, power costs and maintenance charges, any one of which may become the controlling or dominating factor of the entire operating cost. Power costs are easily calculated, but labor costs and maintenance charges are more difficult to estimate, and require

experience and good judgment. It is the designing engineer's duty to consider such factors carefully and arrive at the true operating economy of the proposed plant.

Large and Small Stations

Consideration of the general elements of design leads to the division of sewage pumping stations into two general groups, which for want of a better classification may be designated as large stations and small stations. In general, stations handling in excess of 1,000 g. p. m. of sewage or storm water may be classified as large stations. These stations are characterized by large valves and water passages, large equipment and, where screens are necessary, by elaborate mechanism for cleaning screens and disposing of screenings. Trouble from stoppages is rare because pumping equipment with large clearances and valve passages may easily be provided. Motor driven centrifugal pumps are very often used, and in many cases stations are equipped with oil or gas engine driven generators to provide emergency power. Excellent examples of large stations are the Calumet, Des Plaines and Evanston stations of the Chicago Sanitary District, and the older stations at New Orleans.

Small stations, those pumping sanitary sewage and small quantities of storm water, are much more numerous than large plants, and because they are more often encountered in general design practice, and because they offer problems as perplexing and as difficult of solution as the large stations, the detailed discussion in this paper has been limited to stations of this type.

Preliminary Investigations

Before any station can be intelligently designed, careful preliminary investigations are necessary. If the station is to be located on an established system, actual gaugings of the sewage flowing should, if possible, be made. Studies should be continued long enough to determine the daily maximum flows and the weekly maximums. A careful inspection of the system should be made, and the number of roof connections and cellar drains discharging into the lines noted. If the lines are old there is a possibility of ground water infiltration, which may reach considerable proportions in wet weather. Low places, where perforated manhole covers act as storm water catch basins, should be investigated and recorded.

Infiltration

An attempt should be made to eliminate all unnecessary infiltration, roof water or storm flow. If this is impossible, pumping equipment must be provided to handle abnormal peak loads. Pumping unnecessary quantities of water only adds to the cost of operation and to the first cost of the station for equipment which is used only a part of the time. Where conditions are such as will permit, storm flows of approximately six times dry weather flows may be bypassed around the station. This will depend, however, on whether there is a convenient point of discharge below the station and whether the discharge of such flows would be considered a nuisance.

Capacity

Stations built to serve new districts where sewer mains and laterals are installed coincident with the construction of the station, should be designed to serve the ultimate future needs of the district. Additional equipment can be installed as the district grows. In such a district it is possible practically to eliminate the effect of storm water periods by seeing that pipe joints are carefully made, that manholes are properly set, and that roof connections are not allowed. Grades of sewer mains and laterals can be made steep enough to dispense with flush tanks. The normal flow may be estimated approximately 50 gals. per capita per day, or 250 to 400 gals. per sewer connection per day. Peak loads may be estimated at 175 to 200 per cent of normal flows.

Selection of Equipment

Having determined the capacity of the station, the next step is the selection of proper equipment. This can not be done, however, without a clear understanding of the limitations of certain types of equipment when subjected to this kind of service. Very frequently flows as small as 100 to 500 g. p. m. are encountered in the design of these plants. Pumps designed to handle clear water in such small quantities usually have inlet and discharge openings of 2 to 4 ins., while the clearances through the impeller of centrifugal pumps or the valves of a plunger pump are much smaller. Evperience indicates that clearances through any device for pumping sewage should not be less than 5 and preferably 6 ins., unless the equipment is protected by screens or trash racks of some sort. Self-cleaning screens are out of the question because of the cost, while small bar or wire screens are always a nuisance from the sanitary standpoint, and very often

can not be tolerated. The attention necessary to care for them properly is large and the consequent maintenance costs are abnormally high.

Sewage Ejectors

These limitations of the ordinary types of pumping equipment have led to the development of the pneumatic or air lift systems using sewage ejectors, as they are commonly known. The sewage ejector is nothing more than a cast iron or sheet steel pot, into which the sewage flows through large inlet pipes. When the pot is full a float operated valve is opened, admitting air under pressure on top of the sewage, which is thus forced out into the discharge main. Check valves on both the inlet and outlet sides prevent backflows from the discharge main when the pot is filling ,and backflow into the inlet line when the pot is discharging. Air for the operation of the ejectors is supplied by means of air compressor units, which may be steam, electric motor or gas engine driven. Usually on municipal installations, electric motor drive is employed, with gas engine or gasoline motor standby units provided.

Either horizontal or vertical compressors may be used. In the small sizes air-cooled or hopper-cooled types may be had. For the larger sizes, circulating water must be employed.

Types of Motors

Where compressors are electric motor driven, several types of motor may be used, operated through remote control apparatus actuated by pressure regulators connected to the air receiver. If the motor is less than 5 H. P. it may be thrown directly across the line by means of a magnetic switch. Where motors are thrown directly on the line they should either be oversize or capable of exerting a large starting torque or starting effort. Otherwise an unloader should be used on the compressor, which will allow the motor to come up to speed before receiving its load. For any type motor over 5 H. P., automatic starters, which allow the motors to come up to speed gradually, should be employed. Motors can be connected to compressors either by gearing, silent chain, or belt. Short belt and idler pulley drive is usually employed, although some types of chain drive are as flexible as the belt drive and as positive as gearing.

Ejector installations lend themselves to a number of housing schemes. The ejector pots themselves may be placed in underground wells or pits detached and even removed some distance from the compressor stations. However, it is perhaps best, even though more costly, to build the ejector pit inside the station proper. By this arrangement all the machinery is easily accessible and well protected. It is highly inadvisable to house motor driven compressor units in underground structures. In severe climates some method of heating the station should be provided.

Pumping Station Advantages

From the standpoint of first cost, the ejector type station is at a disadvantage when compared with a pumping station employing centrifugal pumps and screens. It is difficult to give percentage comparisons, inasmuch as conditions of installations vary somewhat, but it is probably true that the ejector station wil lcost at least 25 per cent more than the station using centrifugal pumps. The cost of operating the ejector station will, however, in many cases compare very favorably with the pump station. This is true in spite of the fact that the power costs are higher for the ejectors. The station efficiency of the ejector plant will be in the neighborhood of 25 to 30 per cent, while that of the pump station will be between 40 and 55 per cent. The cost of an operator must, however, be charged against the pump station, while ejector stations, on the other hand, require very little attention other than the oiling of moving parts occasionally. One man looks after a number of the stations, or where there is only one station it is only necessary to delegate a man from some other city department to make the occasional inspections and oiling necessary. It is because of the fact that the ejector requires little care and attention, coupled with the fact that it possesses excellent sanitary features, that this type of sewage pumping station has proved itself satisfactory.

Trash Pumps

Where it is necessary to handle quantities of sewage in excess of 500 gal. per minute, the ejector station, while still capable of the service, is not so well adapted as a centrifugal pump station, using the Wood Trash Pump. The Wood Trash Pump differs from the ordinary clear water centrifugal pump in that there are large clearances through the pump which allow the passage of debris or trash which would stop the ordinary centrifugal pump. The vanes are constructed in such a manner as to take up

very little of the circumference of the impeller. There are no sharp points or edges upon which trash, rags or paper might catch, and the curvature of the ends is such as to tend to oust such rags or trash as might engage the vanes.

It is claimed for these pumps that they will allow the passage of a solid sphere of the next lower standard size than the pump, i. e., an 8-in. pump will pass a 6-in. sphere or anything which will flow around a 6-in. pipe elbow.

Control

These pumps are built in either horizontal or vertical types, suitable for most any type of drive. Motors are usually employed, however, and may be either direct current or alternating current. Several methods of control may be provided. but the most popular and the simplest is a float-operated switch actuating an automatic starter. The installation of these pumps is no different from that of any type of clear water pump running automatically. A closed well should be provided and pumps so set as to remain always primed. No screens are necessary on plants equipped with these pumps in sizes larger than 6-in. and consequently the station may be made entirely automatic, requiring no more attention than is required for the ejector station.

The efficiency of the Wood Trash Pump is remarkable, approximating that of the ordinary clear water pump. In the larger sizes a test efficiency of 76 per cent has been attained. The efficiency curve is flat, which offers an opportunity for a considerable variation in head without a large change in efficiency.

In recapitulation and conclusion, these points are emphasized: First, the designer of the small sewage pumping station should be very careful in determining the capacity of the proposed station. Second, he should pay special attention to the sanitary features of his plant. Third, he should be fully aware of the limitations of ordinary clear water pumping equipment when employed in this service. Fourth, for flows under 500 g.p.m. no class of equipment is as satisfactory as the pneumatic sewage ejector. Fifth, for flows of over 500 g.p.m. the Wood Trash Pump offers the best solution of the problem.

The foregoing paper by Mr. Timanus was presented at the Fifth Sewage Disposal Conference at Iowa State College, Ames, Iowa.

BRIEF OF ANNUAL MEETING OF ADVISORY BOARD ON HIGHWAY RESEARCH

The Advisory Board on Highway Research, Engineering Division of the National Research Council, met in Washington, D. C., Nov. 8-9, 1923. A. N. Johnson, chairman of the Executive Committee, presided.

Highway engineering and transportation, or the construction and operation of the highway, is not a theoretical or academic subject, but a vital part of our economic and social life. We are spending each year in this country a billion dollars for road construction, while the demand for more high-type roads is insistent and growing. The investment in motor vehicles in round figures is 10 billion dollars, and the annual operating cost of these vehicles is some six or eight billion dollars more. With an investment and annual expenditure of this magnitude, can anyone doubt the need of a practical study of the economics of highway construction and operation? This is the field of highway research.

Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, in an address, "Objectives of Highway Research," emphasized the thought that the highway engineer, besides a day's work faithfully done, must also engage in research work if he would advance his profession and himself.

Charles M. Upham, State Highway Engineer of North Carolina, in an illustrated talk, "Research Program of North Carolina Highway Commission," stressed the need of practical highway research and its translation into road service for the highway user.

The chairmen of the various research committees reported results and progress obtained in the past year and outlined a program of research for the coming year. The reports will be later published at length in the Proceedings of the Advisory Board. A brief digest of the committee reports, containing information of practical value, is given.

Committee on Structural Design of Highways

Chairman, A. T. Goldbeck, U. S. Bureau of Public Roads.

1. *Subgrade*

A layer of sand, cinders, broken stone, or other porous material will prevent capillary moisture from rising to the

overlying road surface. Tile drains are inefficient in removing capillary moisture.

Results of tensile, shear, and compression strength tests on various soils are given in detail in the report.

A "Field Test for Moisture Equivalent," described in detail in the report, gives a tentative criterion for classifying soils as to their suitability for use as a subgrade.

The addition of 5 per cent of hydrated lime or Portland cement to a soil materially reduces the expansion and contraction of the soil. The admixture of sand with the soil has a similar effect.

Heat treatment of the soil requires a temperature of 600 degs. C. to effect a physical change in the soil. At this temperature the clay content is reduced and the sand content increased, resulting in a reduction of the expansion and contraction of the soil.

Drainage ditches are effective only in removing water in excess of the capillary moisture.

There is every evidence to show that temperature has a very marked influence on the water capacity of soils. The colder the soils, the greater the capacity for holding moisture.

Some materials, such as many types of clays, take up considerable quantities of moisture when it is available and expand in volume, while other materials, like sand, gravel, crushed slag, etc., take up only enough moisture to coat the surfaces of the particles and show little expansion.

When macadam or broken stone bases are used over a heavy clay subgrade it often happens that the clay is forced up through the voids in the stone and renders the broken stone layer much less resistant to loads. A light blanket of sand or similar material interposed between the subgrade and the broken stone is effective in preventing the clay from working up through the overlying stone layer.

The soil itself does not expand on freezing, but the expansion occurs in the moisture alone.

2. *Sand Clay, Top Soil and Semi-Gravel Roads*

For successful roads, there is required:

(a) Graded mixtures capable of making a dense mass on consolidation. The best mixes run as low as 20 per cent porosity.

(b) Uniformity of composition secured by thorough mixing.

(c) Heavy compacting from the bottom upward. This is usually done by traffic. There is need for a type of multiple rim roller to hasten and unify the degree of compactness imparted to these roads during construction.

(d) The mixtures must have a liberal amount of coarse material above No. 60 sieve.

(e) Depth of compacted surface should be 10-12 ins. Crown of ¼ in. per foot is sufficient.

3. *Forces on Pavements Resulting from Traffic*

Preliminary tests of the Bureau of Public Roads indicate that when driving over a typical concrete road at high speed with a fully loaded 2-ton truck, we may expect impact values of approximately 20,000 lbs., or over five times the static load on one rear wheel. With a fully loaded 5-ton truck at high speed, we may expect forces of 35,000 lbs. to 40,000 lbs., or over four times the static load on one rear wheel. If a downward movement of the loaded truck body occurs at the same instant as an impact, the two forces are of course additive, and the results may be double the impact. Therefore, under certain bad surface conditions a total force of 40,000 to 60,000 lbs. may be obtained at each rear truck wheel.

The semi-monolithic brick pavements showed less resistance to impact than the monolithic brick pavements with same depth of concrete base (Bates Road). The monolithic brick pavements showed about 18 per cent less resistance to impact than the plain concrete slab of equal depth. These results obtained by the Bureau of Public Roads on slabs 7 ft. square.

The observed deflections of concrete pavements are very nearly directly proportional to the load (Pittsburg Test Road).

The resistance to structural failure of plain concrete pavement slabs of uniform thickness and laid on a uniform subgrade, when subjected to highway traffic loads, is in proportion to the square of the thickness of the slab (Bates Road Test).

Structural failure normally first appears at corners caused by open cracks or joints. The edges of ordinary pavement slabs should be strengthened so

that the corners and the edge of pavement may have approximately the same resistance to structural failure as the interior portion of slab.

The endurance limit of concrete, when subjected to repeated tensile stresses, may safely be taken as not less than 50 per cent of the modulus of rupture of the material (Bates Road Test).

Committee on Character and Use of Road Materials

Chairman, H. S. Mattimore, Pennsylvania Highway Commission.

The strength of Portland cement concrete varies with the amount of actual solid material present in a given volume, and with the relative parts of this volume that are cement and aggregate.

Other conditions being the same, the strength of concrete varies with the amount of mixing water. Grading of the aggregate has a decided effect upon the amount of water that may be used to yield a workable mixture. This emphasizes the benefit of using well graded aggregates.

There is need for research to develop methods of making more uniform concrete upon a large scale in practice, in order to apply the information already available on the design of concrete mixtures.

Outline of tentative program of research in bituminous mixtures.

Committee on Highway Finance

Chairman, J. G. McKay, U. S. Bureau of Public Roads.

A budget system as a definite part of the highway program is essential. Under the budget system a fixed amount of highway revenue is necessary for the construction of a relatively fixed amount of new mileage each year, the balance of the revenue being used for maintenance, reconstruction and betterments.

Any plan of state or county highway financing should conform as closely as local conditions permit to the fundamental rules which govern the raising of public revenue: (1) An equitable distribution of the burden between the contributing sources according to the benefit derived from the improvement and the differences in the ability to pay for the improvement. (2) Provide a definite amount of highway revenue yearly. This implies the highway budget system.

It should be emphasized that the use of credit does not solve the problem of distributing the highway costs between the several sources of revenue. The same sources of revenue which finance highway improvements when credit is not used must also provide the revenue to meet highway bonds when funds are borrowed.

The larger the amount of permanent highway investment in existence in a state, the less the real need for the use of credit in financing the improvements. A second factor in determining whether to use present sources of revenue or make use of credit depends upon the wealth of a state and the ability to produce highway revenue from this wealth without unduly burdening it.

The problem of highway finance resolves itself largely into the question of a just distribution between the burden on land or real property, and the burden on the highway user.

Real property taxation for highway purposes bears too large a portion of the burden of highway expenditures, producing, in a survey of four Wisconsin counties, from 55 to 70 per cent of the total highway revenue. The major portion of the burden on real property is due to local and county taxation of real property for highway purposes. In the four Wisconsin counties the local units produce 47.49 per cent; county units, 41.81, and the state 10.70 per cent of the real property revenue for highway expenditures.

The highway user, whose demand for highway service is largely responsible for highway improvements, should assume a larger part of the burden in the form of motor vehicle tax and gasoline tax.

Committee on Economic Theory of Highway Improvement

Chairman, T. R. Agg, Iowa State College.

The following projects have been completed and results published or are in process of publication:

"Truck Performance on Grades" (Michigan Highway Commission and University of Michigan).

"Rolling Resistance and Related Characteristics of Roadway Surfaces" (Bureau of Public Roads, Iowa Highway Commission, Iowa Engineering Experiment Station).

"Economics of Highway Grades" (Iowa Engineering Experiment Station and Iowa State Highway Commission).

"Quartermaster Tractive Resistance of Roads Research."

Committee on Highway Traffic Analysis

Chairman, G. E. Hamlin, Connecticut Highway Commission.

A traffic census will give information pertaining only to the traffic using the

highway at the time the census is taken. A highway transport survey is to determine the probable amount and character of the future traffic which will use a given highway during the lives of its several component parts. No state has extensively taken up the highway transport survey.

After an extended highway traffic census it is recommended that additional counts be taken at critical periods of the year in succeeding years, from which, after a number of counts have been taken, curves of natural increase can be plotted, from which can be roughly determined an estimate of increased traffic for a reasonable period of years. This estimate should also include the curve of increase of motor vehicle registration, which can be determined at the present time in every state.

The value of an extended traffic survey in determining the allocation of construction and maintenance funds in the development of a highway system is unquestioned. Such traffic survey, however, should be utilized for type and strength of surface, rather than for location of expenditures, inasmuch as the development of new territory within a state is as much a demand upon the expenditure of highway funds as the taking care of traffic already developed.

The personnel requires a certain amount of special training although courtesy has been found to be the largest asset. A special sign at the census station giving the reason for the questioning is the greatest factor in reducing the time required to pass a car or truck through the station.

An outline of traffic survey methods and cost in Connecticut is given.

A self-recording traffic counting and weighing device, to operate at minimum cost, is being developed.

A traffic census must include enough detail and be taken over an extended period of time so as to determine the seasonal traffic which varies greatly in certain parts of the country and which is a maintenance rather than a construction problem. The construction type must be based on the heaviest travel rather than on average or seasonal travel. A determination should also include the effect of slow moving vehicles upon the general situation and the consideration of the possibility of legislation which will remove such vehicles to secondary roads during high peaks of traffic to avoid congestion.

Committee on Maintenance of Roads

Chairman W. H. Root, Iowa Highway Commission.

Corrugations form in all gravel roads when the traffic becomes excessive, probably 500 or 600 vehicles per day. Their formation is in no way dependent upon construction or maintenance methods. Corrugations are most apt to occur on flat grades. They are caused by displacement of the material due to the spin of the drive wheels, and by impact of the wheels both front and rear after a bounce. Dragging with heavy equipment after a rain is a temporary corrective.

Use of calcium chloride and refined tar in dust prevention and surface treatment of gravel roads outlined.

Maintenance of gravel road surfaces with a mulch treatment of gravel is giving good results on light traffic roads. The treatment consists of keeping a light application of loose, clean gravel, up to ¾-in. size, on the surface of the road.

A light color of the filler used for joints and cracks in concrete pavement is no longer considered esential. Experiments are being conducted with various grades of tar and asphalt for fillers.

Every state should adopt a distinctive symbol for its route markers.

Warning signs should be uniform in all states and should not be used except where necessity is obvious. Shape, color, size and location recommended in report.

All advertising signs should be forbidden on the highway right-of-way.

Expenditures by the states, through their maintenance organizations, shall be classified in their annual reports for purposes of uniformity and comparison, as follows: 1. Maintenance Administration. 2. Maintenance Proper. 3. Additions and Betterments. 4. Parks, Camping Grounds, and Roadside Beautification. The last three classifications shall be charged to a specific section of road.

Additions and Betterments shall include expenditures for the increased permanent value of the road to accommodate traffic. This will include the cost of: 1. Increased width of surface or roadbed. 2. Increased depth of wearing surface over any previous maximum depth. 3. New guard rails. 4. New walls. 5. New drainage structures and water courses. 6. New subdrains. 7. Improving grades, alignment, and vision.

Maintenance costs should be reduced to a ton-mile unit for comparison between types of road surfaces.

The U. S. Bureau of Standards gave progress reports on "Research on Tires" and "Tests of Braking and Stopping Conditions of Motor Vehicles." Dr. H. M. Westergaard, University of Illinois, discussed "Mechanics of Stiff Road Slabs." These and other papers and the discussion will be published in the Proceedings.

Dean Anson Marston, of the American Association of Land Grant Colleges, was unable to attend the meeting. In a paper, read for him, he pledged the continued co-operation of the land grant colleges and engineering experiment stations of the United States.

An extract from the report of Director W. K. Hatt follows:

"In the three years much progress has been made in quickening the will to research, in mobilizing the energies of research agencies and in assembling the data necessary for judgment upon questions of highway planning, construction and operation.

"It may be said with a large degree of confidence that at present a well trained and experienced highway engineer, in possession of available data, can select a type of highway suitable to the conditions of climate and traffic of a given situation, can specify the materials and design the section with a reasonable certainty that it will withstand the specified conditions of service.

"It is true that the communication of these data to engineers in general has not kept pace with the accumulation of the data nor has a working organization for the process of analyzing the data and translating the discovered principles for the use of engineers been adequately provided. The Advisory Board has published bulletins of information on existing research projects, on apapratus for research and the director has written many occasional papers. Its Research Committees have summarized progress. Much remains to be done, however, in unlocking the stored up data in the files of the state highway commissions which are now such active agencies in highway research."

RESEARCH PROGRAM OF NORTH CAROLINA HIGHWAY COMMISSION AND ITS RESULTS

By Charles M. Upham, State Highway Engineer, Raleigh, N. C.

The immediate necessity in research work is the practical application of our present knowledge already obtained by research. We now have vast funds of knowledge that have been obtained through research, but the benefits obtained by the present knowledge have not been developed to the extent that would be commensurate with the labor and money expended. The reason for this is the non-application of the knowledge already supplied. Therefore, our problem is not necessarily one of research alone, but also a problem of application.

Probably there is nothing new in the fact that North Carolina has a research program, because every state, county or municipality that is carrying on the construction of highways has, to a degree, a research program. In addition to this, laboratories scattered throughout the United States are also carrying on various researches. A survey by the Highway Research Committee disclosed the fact that many hundred programs were in operation. Some of them, of course, were duplicates, but the fact was disclosed that a great amount of research was being carried on.

Practical Application of Research Findings

The difficulties of a research program are numerous, but probably no greater problem exists than keeping research within practical limits and carrying it on in such a manner that when completed, it may have a practical application and serve as a step in working out economically some of the highway problems. Already a vast amount of research knowledge has been acquired and this information is written into bulletins and distributed but, unfortunately, many times the bulletins do not do the most good, because they do not reach the proper persons, nor are they written in a manner that will serve the busy official that generally organizes programs, and so our research problems are still unsolved because the important step of the application of highway research work has not been thoroughly taken care of.

The Problem of Research

The problem of research seems to divide itself into two minor problems—research of the problem itself and the application of the research results. This application is such an important step that it could almost be considered a problem of research in itself, and no doubt a proper study of this application could well afford to be given. We find that a great amount of research has been carried on, but as yet a vast amount of the

knowledge gained has not been applied to road building and, consequently, the economical value of the research has been lost.

In North Carolina every attempt has been made immediately to apply the results of research. Almost every step in construction is being studied in detail and when anything of value is discovered, it is immediately applied to construction on a large scale.

Road Service

Not only does research include problems that may be carried on by the laboratory, but it includes transportation problems—problems that will ultimately render road service to the user of the highway. The great research problem is to render road service to the public by the use of which transportation may be more economically carried on. These major problems of transportation and road service are, of course, influenced by other problems, such as the problems of construction, maintenance and operation. In all highway research there should be constantly kept in mind the question of how the results of this research can influence the road service rendered to the user of the highway.

Sand Asphalt Pavement

One great research that has recently been carried on has been the development of progressive type roads. In certain localities in North Carolina there is practically no road building material, with the exception of sand. The problem in this instance was to devise some means whereby these large quantities of sand could be used in road construction. The answer came in the construction of the sand asphalt road, which is made up of approximately 90 per cent of sand and 10 per cent of asphalt. These roads may be constructed in either single or double track, according to the needs of the traffic and are generally constructed 4½ ins. in depth. This method of construction affords a moderately low-cost road, which renders very satisfactory road service to the locality. It is not expected that this type of road would stand up under a large amount of heavy truck traffic, but it is a development road and is satisfactorily rendering road service to the user of the highway. This road, of course, is the result of laboratory research, but it is in particular the result of the proper application of research work.

Marl Rock Base

In another locality in North Carolina, where there is no stone for road aggregate, there is an underlying strata of marl rock. This rock is the result of a large deposit of shells. While this deposit must have at some time been on the seashore, at the present time it is some 8 or 10 miles from the ocean and is about 4 or 5 ft. below the swamp. This marl rock is being quarried and crushed and is furnishing an excellent base for a sand asphalt surface. While the details of this construction were taken from earlier road work, still the use of this marl rock means the practical application of investigative research.

Subgrade

The studies of subgrades have been demanding considerable attention during the past few years, but there seems, even at this time, to be a lack of properly applying the findings. It has already been determined that different soils are affected differently by the varying amounts of moisture. In some cases, however, no attempt is made in the selection of soils for subgrade purposes. In many localities a proper selection of soils will not only furnish an ideal subgrade but will serve as a road, a subgrade highway, to take traffic up as high as 400 vehicles a day. These selected soil roads may be maintained for a period and then used as an excellent subgrade for the next higher step in construction.

Capillarity

Recent research has brought to light considerable information regarding the capillarity of different soils. For a long period it seemed as though a poor subgrade or a clay condition might be best remedied by the construction of a Telford foundation. Now it appears that the Telford foundation served as a drain to carry away the free water but was of very little, if any, value in taking care of the capillary moisture. Recent experiments have shown that a layer of material similar to sand is a more effective means of cutting off capillary moisture. This explains how excellent results have been obtained in the construction of macadam roads on dry subgrades where the screenings have been spread on the subgrade. It also explains the wonderful results that have been obtained by bituminous roads when they were constructed on a gravel and sand foundation.

Research has shown that capillary moisture is not cut off as well by coarse

material as it is by ordinary sand. The answer to this probably is due to the fact that in the coarse sandy material the high capillary subgrade material finds its way into the interstices of the coarse material and the capillary tubes of the high capillary subgrade material continue to act through the interstices of this coarse material; whereas, in the sandy material, the high capillary subgrade material is excluded and the capillary tubes do not act as freely in the sand. This is a very important point and one that can be taken advantage of and very easily and economically applied to road work on a big scale much more so than is commonly done.

Veneer Surface

Another important application of research work is in the construction of stone veneer on earth roads. In the South there is an exceptionally large mileage of earth roads, consisting mainly of the sand clay, topsoil and gravel types. The bearing power of these roads is high and the strength is great. There is still a great problem surrounding these roads, since they offer very little resistance to abrasion, and with them the dust problem as well. Thus the problem in this particular instance is to secure some means of protecting the surface against abrasion and to abate the dust nuisance. This seems to have been found in the stone veneer surface where the quality of an asphalt wearing surface is combined with the strength of an earth road.

There have been several attempts made in applying bituminous material to earth roads. These in general have been unsuccessful, due to the fact that if the bituminous material was sufficiently light to penetrate the surface, it had no binding power or strength whatever, and if the bituminous material was sufficiently heavy to have a binding value, it would congeal on the surface and peel off, due to the fact that a dust mat was formed underneath the bituminous material.

This problem seems to have been answered by applying a layer of stone of approximately 3 ins. in size to the earth road surface and rolling it partly into the surface, after the surface has been scarified or loosened, and then penetrating the top of the stone with bituminous material of a consistency to give sufficient strength to hold the material in place and afford resistance to wear. This bituminous material is then covered with proper sized stone and rolled and opened to traffic. The stone is held in place from below by the earth road and has become an integral part of it. The bituminous material holds the stone in place on the surface and affords a resistance to traffic abrasion. Thus we have a combination of the strength of an earth road and the wearing qualities of an asphalt pavement. This again is the practical application of research work.

Hard Surface Types—Coarse Aggregate

Another problem in construction is the ideal construction of hard surfaced roads. Much laboratory research has determined that the aggregates must be of certain qualities and properly graded. Recent experiments in concrete work have shown that much depends upon the grading of the aggregate. While the early tests indicate that a large aggregate gives a higher strength value, long time tests seem to show that the aggregates below an inch and a half give higher strength values. While in this instance we have a research giving one result, still it is impossible to apply this in its entirety, due to the fact that the present arrangement of crushing plants and aggregate production machinery do not furnish economically an aggregate that gives the highest ultimate strength. Therefore the proper application of this research is in a compromise approaching the ideal conditions.

Core Drill

At the present time considerable research is being carried on attempting to correlate the laboratory tests of materials to the final product as found in the pavement by the core drill. At the present time it seems that there are so many variable factors that it is impossible to control all of them and as a consequence, the results of the final product vary considerably.

Not only have studies been made of the coarse aggregate, but a new test for fine aggregate has been developed, which seems to permit a larger percentage of fine aggregate to be used, or, in other words, aggregate that would be condemned under the standard test, can now be used with safety. This test consists essentially of testing the aggregates directly and in the final product in compression and transversely and not in tension as is done in many of the present day standards.

Investigations in cement also show that this material varies considerably

and the final strength of the road depends primarily upon the quality of the cement used. It seems that individual brands may vary considerably. This may not be only a question of manufacture, but also one of storage and handling until the cement is used.

Surface Finish

Possibly there is not a single demand on a pavement as great as the impact of traffic. Impact depends entirely upon the smoothness of the road surface; therefore, considerable study has been given to obtaining smooth surfaces. This has been put into practice by devising various means of finishing the surface.

In the question of concrete, it is found that the smoothness of the surface depends on many factors, some of the chief ones being the consistency of the concrete as well as the character of the subgrade. This subgrade, after being wet by the concrete, expands or contracts and the green concrete in the road surface does the same. Various types of check templates are being used to check the surface before it sets up so that it may be corrected while still plastic. In the case of the bituminous roads test boards and straight edges are used during construction and then after the road has been opened to traffic it is again tested. Recently experiments have been carried on with the vialog, which is an instrument recently devised for measuring unevenness of road surfaces.

There has been much discussion relative to the detailed construction and maintenance research problem, but probably the greatest problem and the most immediate need is a solution of the proper methods for taking the research work that has already been done and applying it practically. This leads us to the problem of organization and personnel and the varying results obtained in the work show the influencing factor that personnel has on any undertaking. Research with construction and maintenance problems deals with definite qualities, but research, organization and personnel deal with varying factors of the human mind and thus are more difficult to solve. The proper and economical application of research work is also research along the lines of personnel and organization. It is useless to spend time, money and effort in carrying on research unless the results are applying in a way that will more economically solve our problem, and in order that the facts may be used to the greatest advantage, they must be presented to the proper persons in a way that is definite, concise and easily understandable.

The foregoing paper by Mr. Upham was presented at the recent annual convention of the American Association of State Highway Officials.

RECENT OBSERVATIONS ON SEWAGE DISPOSAL WORKS IN EUROPE

By George W. Fuller, Consulting Engineer, 170 Broadway, New York, N. Y.

When visiting a few sewage disposal projects in Europe recently, my attention was directed to several features which may be of interest, as follows:

1. Adoption of the activated sludge process in England goes forward steadily. Plans are being adopted and plants are being built both with the air diffusion of oxidation and mixing and with mechanical circulation arrangements.

2. At Reading, England, a town of 60,000 population, the air diffusion method has been adopted and the works are now under construction by Activated Sludge, Limited. The sludge will be dried on 8 acres of untreated city refuse. The Hanley plant with the same style of aeration is now in service. The surplus sludge is pumped back into the preliminary sedimentation tank, whence the mixed product is pressed and sent to the dump.

3. At Sheffield, the mechanical circulation arrangement of Haworth with paddle wheels has been in service for three years in treating about 500,000 gals. of sewage daily after it has been passed through preliminary sedimentation tanks holding about one hour's flow. By the end of the year the Sheffield works will have in service two new units, each rated at a capacity of 1.25 million gallons of dry weather flow daily. Mr. Haworth informs me that this type of installation of the activated sludge process has been adopted at places where works are either in operation or under construction for projects of daily capacities as follows:

Sheffield (2) 15,000,000 gals. and 500,000 gals.
Wakefield (2 schemes) 5,000,000 gals. and 400,000 gals.
Rotherham, 2,000,000 gals.
Mansfield, 500,000 gals.
East Ham, 500,000 gals.
Barnsley, 500,000 gals.
Stockport, 5,000,000 gals.

Taunton, 750,000 gals.
Burnley, 500,000 gals.
Burley-in-Wharfedale, 500,000 gals.
Chesterfield, 2,000,000 gals.
Paris, 500,000 gals.
All quantities are in Imperial gallons.

4. The Bury device, patented by Bolton and sold by the Ames Crosta Sanitary Engineering Co., Ltd., has been adopted by Mr. Watson at Birmingham. This plant has a daily capacity of 2.5 million gallons daily and is provided with aerating channels holding 140,000 gals. or a retention period of about one hour during which the velocity flow is 1 ft. per sec. for the sewage which has previously passed through sedimentation tanks holding about 12 hours' dry weather flow. The purpose of this plant is to remove colloidal matter, lessen the odor at the nozzles of the sprinkler beds to which the settled effluent of the activated sludge plant will be applied, and also to increase materially the rate of filtration of existing beds. The activated sludge after sedimentation in Dortmund tanks will pass through reaeration chambers holding about 6 hours' flow and where the aeration will also be provided by the device with its revolving aprons attached to a motor-driven vertical shaft. From the results of the tests made last year, it is expected that about 95 per cent of the suspended (organic) matter of the sludge will disappear through wet combustion and the surplus not needed for return to the influent of the main aeration tanks will be sent to the sludge digestion basins.

5. On Oct. 1, 1923, the official opening of the new low level sewage pumping station occurred at Leeds, where the main treatment will be provided by tanks and sprinkler beds 30 acres in area and of which 10 to 15 acres are completed. Another large sprinkling filter plant on which the construction was begun during the past year is at Bradford, where there will be 60 acres of 6-ft. beds of fine coal.

6. The London County Council, at its Crossness works, is conducting comparative tests in tanks holding about 24,000 gals. to show the relative merits of the air diffusion and of mechanical circulation arrangements of the Haworth type. The tests which include one set with the sewage aerated by flowing from a tank through a spray jet, are being conducted with London sewage which has previously been subjected to sedimentation for about 25 minutes.

7. There is not yet adequate information to show which is the best way of conducting the activated sludge method as regards aeration by air diffusion or by either of the two well-known types of mechanical circulation. It will take considerable information to develop needed comparative data to throw needed light on the economics of the problem and particularly upon flexibility and reliability of the several devices in meeting the varying conditions encountered on a working scale. The need of such information is realized in England, but in view of the fact that each of the three arrangements seems to serve its purpose under good management, there is no great speed being shown in the development of adequate comparable data which ought to be secured jointly from an engineering, chemical and biological viewpoint, having due regard for the economics of the situation, under practical working conditions.

8. Stream Line Filters have been very recently proposed for dewatering sludge, but otherwise there have been no new developments except the Reading scheme as above mentioned and those described by the writer in articles appearing in Engineering News-Record, February, 1923.

9. The early summer of 1923 was very dry in England. Some use of chemicals was understood to have been made at the plain sedimentation works of the London County Council and conditions at Glasgow have become such that substantial quantities of chemicals are added there to precipitate finely divided suspended matter, not removed by plain sedimentation.

10. Centrifuges are being used at Frankfort for dewatering sludge to a spadable condition during about 6 months of the year, during the cropping season, while during the colder season of the year the sludge is applied directly to farmlands to save the cost of centrifuging.

11. At Berlin the sewage farms are being operated as usual. Due to the annexation of numerous suburbs giving the city now a population of over 4 million people, there have been abandoned a number of small plants in the suburbs both for water supply and sewage treatment. It is even proposed to abandon the large sprinkling filter beds at Stahnsdorf during the coming winter in order to utilize the coal of which the beds are built.

The foregoing matter was presented by Mr. Fuller at the recent annual convention of the American Society for Municipal Improvements.

DESIGN AND CONSTRUCTION OF HIGHWAY LIFT BRIDGE OVER MYSTIC RIVER AT MYSTIC, CONN.

By Wm. G. Grove, American Bridge Co., 30 Church St., New York, N. Y.

The bridge carrying the New York and Boston Post Road over the arm of Long Island Sound at Mystic, Connecticut, having become inadequate for the heavy modern interurban electric car and auto-truck service, the State of Connecticut decided about 1918 to replace the bridge with a new structure designed to meet the needs of present and future traffic on this very important interstate highway.

Description of Old Bridge

Several bridges were built over the Mystic River at this site during the last century, the third bridge being built about 1886. This structure was removed in 1904 and replaced by a through riveted truss swing span 151 ft. center to center end bearings, with a clear roadway of 21 ft. This type of movable span provided for two navigation channels each 49 ft. in width. It was designed for a single car track with a roadway and sidewalk either side. Short approach spans connected each end of the draw span with the abutments. This bridge gave satisfactory service until the introduction of heavy interurban cars and large auto trucks made it imperative to provide for a bridge of great capacity.

Considerations Governing the Type of New Bridge

The river at this point being a navigable stream and therefore coming under the control of the United States War Department, it was stipulated that the new bridge should be of such type as would provide for a channel of 75 ft. clear width and 135 ft. clear height. The State of Connecticut specified that the bridge should have a clear roadway of 33 ft., with provision for a single car track on the center line of the bridge, and that there should be a sidewalk 5 ft. clear width on each side of the bridge. This necessitated a bridge of 48 ft. 6 in. center to center of handrailings.

Various types of movable bridges were considered for this opening. The relatively great height of required channel clearance compared to the length of span, excluded the vertical lift type. The extreme width of the bridge, practically 50 ft. overall, would require a swing span of at least 210 ft. center to center of end wedges if the bridge was symmetrical with both arms of equal length. Buildings at both ends of the bridge extended up to and in some corners in front of the abutments so that a symmetrical swing span would extend about 25 ft. over the west abutment, thus making a bobtail swing span the only solution of this type.

The elimination of the swing and vertical lift necessitated the use of a bascule, and after careful consideration, and comparative estimates, it was decided to adopt the "Brown Balance Beam" type, a new type, patented in 1918, of which the bridge described is the first example.

Description of New Bridge

With a clear channel width of 75 ft., the main lift was made a through plate girder span 84 ft. 8 in. center to center end bearings, resting on piers 88 ft. center to center. The tower span is a through plate girder, 23 ft. center to center bearings, located west of the bascule span. To complete the crossing there are two through plate girder approach spans one 33 ft. 6 ins. center to center bearings and one 67 ft. center to center of bearings at the east and west ends of the bridge respectively.

The main girders on all spans are 36 ft. 6 ins. apart with floor beam and stringer floor construction.

The lift span is counterbalanced by two concrete weights, one at each side of the bridge, carried by balance beams in the form of trusses which rest on trunnions at the tops of the tower bents. These trusses are about 60 ft. long and their forward ends are connected with the plate girders of the lift span by non-rigid suspenders consisting of eye bars and short links having double sets of pivots at the span end. Stops are suitably placed on the upped chords of the lift span girders to contact at the proper time with the short links and so change the point of rotation of the suspenders from one set of pivots to the other. This system of multiple pivots is the important distinguishing feature of the New Brown type. By means of this construction, the angular motion of the counterweights is less than the angular motion of the lift span, and hence the span may be raised to a vertical position without the counterweight passing between the tower bents, and therefore the weights,

tower bents, and lift span girders may all lie in the same plane. The concrete counterweights at the rear end of the trusses are provided with the usual pockets for adjusting blocks.

The specifications called for the span to be opened to the 90 deg. position in 90 seconds. The main source of power is 3 phase, 60 cycle, alternating current delivered to the bridge site at 220 volts. It is there transformed down to 220 volts and carried to two 36 h. p. induction motors located under the sidewalks, one motor on each side of the bridge. From each motor the power is transmitted to a worm gear unit having a ratio of 20 to 1. From the worm wheel the power is further transmitted by 3 reductions to the rear end of a large bull wheel section located above the floor and in the plane of the tower bent and main girder. The forward end of the bull wheel section is connected by links to an operating trunnion on the main bascule girder. The two independent machinery reductions are connected by a small transverse shaft extending across the bridge.

The bull wheel operation eliminates the necessity for end locks and the worm gear units avoid the use of high speed spur gearing and hence the operation of the bridge is remarkably smooth and noiseless.

The motors are provided with solenoid brakes on the motor shafts connected so as to be ordinarily set and released when current is applied to the first point on the controller. By this arrangement, should the current for any reason be suddenly cut off, the brakes will automatically act to hold the bridge in the position it occupied at the time of cut off. In addition to the solenoid brakes there are provided emergency air brakes so arranged as to be applied in case the main brakes failed to operate. These emergency brakes are controlled by air at 70 lbs. pressure, supplied from a reservoir, which is filled when necessary by an electric air compressor.

At the center of the transverse shaft connecting the gearing across the bridge there is a bevel gear fixed on the shaft. A removable pinion and capstan afford means to operate the bridge by hand should the electric current fail from any cause.

Removal of Old Swing Span

The State built a temporary wooden trestle to the north of the bridge site, and about June, 1921, diverted all highway traffic, except the electric cars, over this trestle. The electric line was cut; on the west end of the bridge cars were operated between Mystic and Groton, while on the east end they operated between Mystic and Stonington. The removal of the old draw span was then done by the state of Connecticut during June and July, 1921.

Substructure

The work on the substructure consisted in removing the old piers and building 3 new piers and 2 abutments. Work was started in July, 1921, and was practically completed in February, 1922.

Construction of New Steel

The contract for the steel superstructure and machinery, with floor, rails, paving, operator's house ready for traffic, was awarded to the American Bridge Company in August, 1921. Drawings were made at the Edge Moor plant [now discontinued), and the steel work was fabricated at the Pencoyd plant. Nothing unusual was experienced in the shop, the character of the shop work being similar to other lift bridges of the bascule type.

The design of the bridge was well developed on the consulting engineer's plans, so that the drawing room work was largely in adapting these plans to shop standards.

Erection

As there were no proper facilities for a dock near the railroad station at Mystic, which would have necessitated a short haul from the station to the bridge site, it was decided to erect the steelwork by lighter. The steelwork was therefore consigned to New London and loaded on one lighter of 200 tons capacity and one barge of 300 tons capacity. The heaviest pieces to lift were the two main bascule girders, each weighing approximately 25 tons. The lighter, which was the property of the T. A. Scott Company, had a 96-ft. boom with a capacity of 50 tons.

The steelwork finally reached New London the latter part of April, 1922, and was loaded on the lighter and barge and towed the 10 miles east on Long Island Sound to Mystic. The steelwork for the two approach spans and the tower spans was then placed by the lighter and then the steel towers themselves erected.

After the main trunnion bearings at the tops of the tower were properly aligned with the main bascule girder trunnions, the two counterweight trusses were lifted into the horizontal position, the forward ends resting on a temporary wooden bent, and the rear ends guyed back by ropes.

The question that had been given considerable study was whether the concrete

counterweight should be placed with the bascule span in the open or closed position. There were advantages and disadvantages in either method.

By erecting in open position, the counterweight would be placed at practically roadway level, with simplicity of form work, particularly at the pockets. These pockets, which were left open for the adjustable blocks, were in open position, at the top of the counterweight. It was, however, more difficult to place and hold the main girders in upright position and then erect the balance of the steel of the bascule span. This, however, as well as the placing of the main portion of the wood floor could have been accomplished, but it was practically impossible to lay the wood block wearing surface properly on the roadway and the reinforced concrete sidewalk slab with the span open from 75 deg. to 90 deg.

On the other hand, the erection of the span in closed position would facilitate the complete erection of this span, including the wood floor, wood blocks, sidewalk concrete and hand railing. This would mean, however, that the counterweight would have to be placed in the high position, requiring staging to support the concrete forms.

A modification of this scheme was considered, whereby the steelwork of the bascule span would be erected in the closed position. The span would then be raised by block and tackles and the wood floor placed in open position. The counterweight could then be poured in low position, using a small amount of staging. The span would then be hauled down by a line attached to the toe end, and the wood block and sidewalk slab finally placed with the span down.

This modification was, however, not carried out, and after mature consideration it was decided that greater speed and safety could be obtained by erecting the entire bascule span closed and the counterweight in high position.

The west approach girder was designed to take one half the weight of the concrete counterweight when the latter was in open position, in which position it was about 8 ft. from the pier. In raised position the counterweight was about 24 ft. from the pier, so that the girder was not strong enough to support the counterweight in this position with the additional framework and staging required. To remedy this some wire guys or ties were attached to the top of the counterweight truss to support a slab formed by pouring about 2 ft. of concrete and allowing this to set. The additional weight of the concrete was then carried by the counterweight truss. This method proved to be entirely satisfactory.

While the concrete counterweight was being placed, the steelwork for the bascule span was erected in closed position and the wood floor, wood blocks and concrete sidewalk placed thereon. Simultaneously the machinery was erected and the shafting lined up. The electrical equipment was installed and the transformers placed in position near the operator's house.

The structure was then practically finished and ready for the balance tests, which were made on July 13, 1922. These proved to be satisfactory, and the Highway Commissioner then formally declared the bridge open for traffic, which event was appropriately celebrated by the towns of Mystic, Groton and Stonington.

A special feature in connection with the field work was the boring and framing of as much of the lumber as possible at the mill. The steel erectors are averse to handling creosoted lumber, and on this bridge it was decided to relieve them of a large portion of this work. The spiking pieces, curb guards, ties and other miscellaneous lumber were bored and framed before creosoting, so that very little field work was necessary on this lumber, the principal field work being boring where steelwork or other boxed lumber was used as a templet. The lumber was also given marks similar to shipping marks on the steelwork. The erection department was well pleased with this method of handling the lumber, as it not only saved field expense and time, but also relieved the erectors of an uncongenial task.

Conclusion

The bascule and tower spans were of the design patented by T. E. Brown. The approach spans were designed by the State Highway Department of Connecticut. The substructure work was done by the J. E. Fitzgerald Co. The structural steel superstructure was fabricated by the American Bridge Company at Pencoyd plant, and erected by the Eastern Division erecting department. The electrical equipment was installed by the American Bridge Company. The concrete counterweight was placed by the C. A. Sibley Co. The wood block pavement was furnished by the Jennison-Wright Company and placed by the Standard Engineering Co.

THE COST OF ADEQUATE STREET LIGHTING

By L. A. S. Wood, Manager Street Lighting Section, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

The advantages to a city of an improved street-lighting system are thoroughly appreciated by the public, but the cost of adequate street lighting is not so well understood. This is a subject of the utmost importance to municipal officials, and a clear analysis of the whole situation is necessary before the cost of adequate street lighting can be determined.

The conditions governing the cost of adequate street lighting are the same with municipally operated street-lighting plants as with a public utility service, and, in either case, the public must ultimately pay the interest on the investment and a fair depreciation on the equipment, or the system cannot be operated satisfactorily. We cannot get "something for nothing," and if a city wishes to possess an adequate street-lighting system, it should be prepared to pay adequate rates to obtain it.

Misleading Conditions

The public, unfortunately, has been to some extent misled as to the cost of street lighting, due to the fact that in the early days of electricity, street-lighting rates were not always based on the actual cost of the service, but were often quoted in consideration of some concessions in connection with the granting of the franchise. Furthermore, street-lighting rates have remained practically constant for many years, and we are paying today little more per capita for street lighting than we paid 20 or 30 years ago. In view of the enormous increase in the costs of labor and material in recent years, this is manifestly unfair and we are led to ask, how is the service maintained under these conditions?

Advances in the Art of Lighting

Public utility companies and municipal street- lighting plants have been able to maintain street-lighting service with existing rates and appropriations, because of the developments in street-lighting units which have increased the efficiency of the units and reduced the costs of labor and maintenance. The introduction of the Mazda C lamp and the consequent reduction in trimming costs was coincident with the rapid increase in the cost of labor and material. As a result of this development, the arc lamp, which up until 1913 was the standard unit for street lighting, was rapidly replaced by the Mazda C lamp, and street-lighting services were maintained without increases in the rates.

From the foregoing remarks, it is evident that the sale of street-lighting service at existing rates is not profitable and consequently is not an attractive business for the central station. Superficial observers might conclude that a low rate for street lighting would be advantageous to a city, but unless the business is profitable, the central station not only has no incentive to improve the service, but it has no funds available for this purpose. The result of this condition is a poorly maintained street-lighting system with dirty glassware and inefficient service.

It would be logical to assume that if the investment required for adequate street lighting returned a fair interest, the public utility companies would be energetic advocates of improved street lighting, whereas, at the present time, they are in general not interested in advocating improvements requiring an investment which might have to be covered by an inadequate rate.

Lighting to Fit Rates

An interesting side-light was thrown on this situation at the recent Annual Convention of the Illuminating Engineering Society, at which eleven authorities on street-lighting practice presented their solutions of a typical street-lighting problem. Copies of the problem were sent to central stations, consulting and manufacturing engineers, and a tabulation of the intensities of illumination recommended shows that those suggested by the central station engineers were, on the whole, lower than the intensities recommended by the other engineers. In the discussion it developed that the central station experts had been guided in their recommendations by what they believed, from previous experience, a city would be willing to pay for a street-lighting system, and not by what they thought would be adequate to take care of modern requirements. It is my belief that this attitude on the part of central stations will not be changed until municipal officials and the public realize that to obtain adequate street lighting, adequate rates must be established.

Adequate Rates

What is an adequate rate for street lighting? This is a difficult question to answer, because the rate will depend largely on the locality and size of the city under consideration. In general, however, an adequate rate for street lighting is a rate which will return a fair interest on the investment required for an ade-

quate street-lighting system, and one which will provide for the efficient maintenance of the system, and a reasonable depreciation on the equipment.

Unfortunately, while provision is occasionally made for an adequate street-lighting system, municipalities often overlook the importance of establishing a rate for the service which will provide for adequate maintenance. The efficiency and appearance of a street-lighting system depreciates rapidly unless glassware is cleaned at regular intervals, and it is quite evident that unless an adequate rate sufficient to cover adequate maintenance is established, little effort will be made by the public utility company for a growth in what is an unprofitable load. To keep the street-lighting losses as low as possible, the central station with an inadequate rate for street-lighting service, will be apt to neglect the equipment which, in consequence, will fail to operate at normal efficiency.

"Outages"

As a legacy from the days of the arc lamp, city administrations generally keep a record of "outages" in order to collect penalties imposed under the terms of the street-lighting contract, although, with modern street-lighting equipment, such outages are comparatively few. "Semi outages" caused by dirty glassware or blackened lamps generally pass unobserved, even though such "outages" are a greater factor in the efficiency and appearance of a street-lighting system than the actual outages. Central stations and municipal plants cannot be expected to take care of such conditions unless adequate rates are established.

It is generally conceded that the cost per capita for an adequate street-lighting system should not be less than one dollar, and yet, an investigation into this subject disclosed the fact that there were only nine states in the Union in which the per capita expenditures of municipalities for street lighting exceeded 90 cts, and only four where the expenditures were more than one dollar. At the time the investigation was made, it was found that the average expenditure for the whole of the United States was approximately 71 cts. per capita. (Report of the Lighting Sales Bureau, National Electric Light Association, 1921.)

Budgets for Lighting Are Small

Street-lighting budgets form a small portion of total municipal expenditures; and, while there have been large increases in practically all departmental expenditures, which in some cases have nearly doubled in the past ten years, there have been only slight increases in the street-lighting budgets. An investigation of municipal finances was recently made to determine "just where the tax dollar goes," and whether a fair proportion is expended on street lighting. This disclosed the rather startling fact that while 21 cts. of each dollar "goes" for protection (police, fire, etc.,) only 3.4 cts. "goes" for street lighting.

The cost of adequate street-lighting systems can often be reduced if the street-lighting improvement schemes are carried out under a comprehensive program co-ordinated with and included in city zoning plans. In designing ornamental street-lighting installations, the most important consideration is to obtain efficient illumination at night at low operating costs, with units which will add to the appearance of the streets by day. The original cost of a street-lighting installation is seldom greater than its cost of operation over a two-year period. Most installations last from ten to fifteen years, so it is plain that a little saved or spent on the original installation becomes an insignificant consideration when compared with the importance of wise planning from the standpoint of maintenance and operating costs.

Patchwork

In past years the usual practice has been to confine street-lighting improvements to limited areas. Just as city planning has in past been almost wholly confined to scattering about the city a few beauty spots, such as civic centers, parks and play-grounds, so has improved street lighting been scattered through the agency of localized improvements carried out as private developments, or in the form of improvement districts. Nearly always the aim has been to boom a restricted area to commercial leadership through the establishment of "White-Ways." The work of so-called improvement districts may be made valuable if regulated under a general improvement plan; but without centralized leadership the result is haphazard patchwork.

Criticisms of Ordinary Lighting

The average run of street lighting throughout the United States is more or less subject to the following criticisms which are approximately in the order of their relative importance:

1. Inadequate illumination.
2. Miscellaneous growth without a

definite relationship to a comprehensive city plan.

3. Inconsistent transitions and gaps in passing from one section to another.

4. A lack of standardization.

5. A lack of classification of streets and an absence of unity of treatment of streets of the same classification.

6. Too many unsightly and disfigured streets, because of insufficient attention to architectural grace and ornamentation.

7. Too much temporary construction instead of building for flexible permanence.

8. Too little application of correlated effort, research and talent.

Correlation with Zoning

A scientifically derived, comprehensive, far-sighted street-lighting program correlated with a city-zoning plan is not easily worked out. It calls for specialized talent in many lines of work, and, in most cases, city officials can profit by bringing into consultation the engineers found in public utility companies, whose success depends largely upon their ability to foresee future requirements and to meet them with a minimum loss in reconstruction. This nation is becoming possessed of may vast cities and most of them—like "Topsy"—"just growed." Our large industrial establishments and other privately owned projects exemplify the economy of employing talented engineers and architects. The city is, of course, more important than any of its contributing factors; and it is unfortunate that some of our cities do not appreciate the necessity of providing sufficient appropriations for this type of personnel.

Constructive Suggestions

In conclusion, I have the following suggestions to offer:

1. That municipal officials seriously consider the cost of adequate street lighting, and assist in the establishment of adequate rates for adequate street lighting.

2. That municipal appropriations for street lighting be increased. It is quite evident that there is room for improvement in this direction.

3. That municipal officials energetically co-operate in the efforts which are being made to include provision for adequate street lighting with city zoning plans.

The foregoing paper was presented at the recent annual convention of the American Society for Municipal Improvements.

DEVELOPMENT OF HIGHWAY BUILDING POLICIES IN NORTH CAROLINA

By H. K. Witherspoon, Publicity Engineer, North Carolina State Highway Commission, Raleigh, N. C.

Beginning with a small appropriation by the Legislature of 1915 highway building has, within the past few years, come to be one of the leading industries of North Carolina and while a relatively large expenditure of money is necessary to carry on a large road building program, no enterprise in the State is paying, or will in the future pay, larger dividends than the system of good roads which is being built by the State Highway Commision. These benefits are not to be measured in terms of dollars and cents, but rather in the improvement of the social and economic life of the State.

Briefly, the history of road construction under a State Commission began, as stated above, with the appropriation by the Legislature of 1915 of $10,000 and the appointment of a Commission of seven men, including the Governor who acted as chairman. This step was taken in anticipation of the passage of the Federal Aid Road Act which was ratified by Congress in July, 1916. The General Assembly of 1917 enacted further legislation which placed in the hands of the Commission the funds derived from automobile registration but with the stipulation that 70 per cent of the funds was to be expended in the county from which it was collected. This often resulted in the county having the least mileage to maintain receiving the largest allotment while several counties having a larger area, and consequently a larger mileage of roads, but a smaller number of automobiles, received an allotment insufficient to do any worth while maintenance. This unfair division together with the fact that the responsibility for maintenance was left with county officials did not result in efficient results.

With the passage of more far-reaching highway legislation by the General Assembly of 1919, road work in the State took on new life and while this law was far from perfect it marked a decided step forward and its enactment symbolized the beginning of real highway work. Briefly, the law provided for a Commission composed of four members who had entire charge of all construction of roads on the State Highway System; for the working of convicts from the State Prison on highways; to assist the coun-

ties in highway work; and to provide for the expenditure of Federal Aid funds. All revenue from the taxing of automobiles was held by the State Treasurer as the "State Highway Fund" and used for the construction of a system of State highways and to meet the allotments of Federal Aid funds. Counties agreeing to furnish one-fourth the cost of construction of a road in that particular county were given preference in priority of construction. Under this plan one-fourth of the cost of construction was paid by the county; one-fourth from the State Highway funds; and one-half from the Federal Aid fund.

A number of counties took advantage of this opportunity and consequently a number of miles of improved highways was added to the State Highway System. Bunt unfortunately the poorer counties could not avail themselves of this Federal Aid on account of their inability to furnish their own part of the necessary funds. During the two year period that this Commission functioned under the 1919 law approximately 200 miles of improved highways were completed at an approximate cost of $2,464,000, and 650 miles, estimated to cost $9,730,000, were placed under construction. One of the weak points of the 1919 Act was the fact that maintenance work was left in the hands of county officials and this resulted in more or less piecemeal work throughout the State. The State Highway Commission only assisted in a supervisory and co-operative way as far as possible.

Realizing the need for a more extensive road-building program and realizing the necessity for a more adequate system of maintenance, certain far-sighted citizens of the State began an intensive good roads campaign in 1920, which resulted in the passage by the General Assembly of 1921 of the Doughton-Connor-Bowie Act. The purposes of the law are well expressed in Section 2, which reads as follows: "The general purposes of this act are for the State to lay out, take over, establish and construct and assume control of approximately 5,500 miles of hard-surfaced and other dependable highways running to all county seats and to all principal towns, State parks and principal State institutions, and linking up with State Highways of adjoining States and with National Highways into National Forest Reserves by the most practicable routes, with special view of development of agriculture, commercial and natural resources of the State, and for the further purpose of permitting the State to assume control of the State Highways, repair, construct, and reconstruct and maintain said highways at the expense of the entire State, and to relieve the counties and cities and towns of the State of this burden." In short, the Act provided for a State Highway Commission consisting of a chairman from the State at large, and for one Commissioner from each of the nine districts into which the State is divided; all engineering work was in charge of a State Highway Engineer appointed by the Commission; funds were provided for construction by the issuance of serial bonds aggregating $50,000,000, and maintenance funds from automobile license fees, and from a tax of 1 ct. per gallon on motor vehicle fuel. In addition to these funds, there was allotted to the State under the Federal Aid Act ratified in November, 1921, approximately $1,709, 334 for expenditure in 1922, in connection with an equal amount of State funds.

The General Assembly of 1923 amended the 1921 Act by authorizing an additional bond issue of $15,000,000 and increasing the tax on gasoline from 1 to 3 cts. Section 27 of the law as amended sets forth clearly the method of handling these funds. It reads as follows:

"That for the purpose of carrying out the provisions of this act and provide for the maintenance and construction of the highways contemplated under this act from the funds derived from the various taxes levied under this act, there shall first be set aside the sum of two hundred and fifty thousand dollars ($250,000) annually, or so much thereof as may be necessary to defray the expenses of the State Highway Commission. From the remainder of said taxes there shall then be set aside annually the following, in order named: (a) a sum sufficient to pay the interest upon the first fifty million dollars bonds issued under this act in excess of fifty million dollars and, (b) any interest or sinking fund payments now or hereafter directed to be made therefrom by the General Assembly. The remainder of such fund shall be used by the Highway Commission in the maintenance of the highways taken over under the provision of this act, and to be adopted and designated by the Commission as State highways under the provisions of this act; any part o fthe two hundred and fifty thousand dollars ($250,000) set apart for the expenses of the Commission, and any part of the balance unexpended in the payment of interest on the bonds, shall pass each year under

the control of the Highway Commission and be used by it in the maintenance and construction of the State system of highways herein provided for. All funds derived from the taxes herein levied, or from the sale of the bonds herein provided for, may be used by the Commission in meeting the requirements of the United States Government as to Federal aid: Provided, that all necessary expenses of collecting the said license or registration fees or other State highway funds hereinafter provided for, including clerical assistance, the cost of furnishing number plates and mailing same, and for such blanks, books and other supplies as cannot be furnished by the State printer, shall be paid for monthly by the auditor from the revenue derived from fees or taxes that are collected, said expenses shall be approved by the Governor and Council of State, and shall not in the aggregate exceed 10 per cent of the total amount collected by the Secretary of State under this act."

The average layman cannot grasp the magnitude of this enterprise in which the State is now engaged, nor does he realize the investment that the State is making in a network of modern highways. At the present time road and bridge work under contract and construction totals $39,277,527 and includes a mileage of 1,952 miles. If built in a single stretch, this mileage would extend more than twice across the State following the route of the Central Highway. Approximately 1,022 miles of this total is being hard surfaced at a cost, in round figures, of $29,925,000 while 922 miles are being graded and surfaced with sand clay, topsoil or gravel at a cost of $8,341,000 and bridge work costing $1,011,307.

No road, regardless of its type or how well it is built, will stand up under the wear and tear of traffic unless it is given constant care and attention. This statement is contrary to the belief that existed in years past when, after construction was finished, no thought was given to the upkeep of the road. In this failure to maintain the roads already built the counties are losing much money.

Realization of the necessity for maintenance led to the organization of a highly efficient system of maintenance, one which has wrought wonderful results even in the short time that it has been at work. At the present time there are about 1,200 men engaged in the upkeep of State roads. These men are responsible for the condition of 5,750 miles of road on which they are working daily. Based on a per capita cost per day per person, or based on 1923 statistics, which show that there are 12.4 people to every automobile in North Carolina, brings the cost of keeping the State roads in first class shape to approximately two and two-tenth cents per car per day—an insignificant sum when one considers the lessening of depreciation on the car itself, the wear and tear on tires, the saving of gasoline and oil, and by far the most important, the immense amount of time saved.

One does not have to belong to the older generation to have vivid recollections of the time when North Carolina roads were of such character and in such condition, due to lack of attention, as to be almost impassable during part of the year. The coming of motor cars and the realization of the thinking people of the State that North Carolina, like a human being, was no better than its arteries, have wrought a marvelous change in conditions. Within a few years this State will have as fine a system of all-the-year-round roads as can be found anywhere, the outgrowth of which will be the development to the highest point of the industrial and agricultural resources of North Carolina.

SOME PAVEMENT TYPES AND PRACTICES OF TEXAS CITIES

By W. J. Emmons, Professor of Highway Engineering, Agricultural and Mechanical College of Texas, College Station, Texas.

The question of selection of the type of pavement for a city street is one of considerable complication and one which has disturbed the equanimity of city councils since the first municipal improvement of this nature was inaugurated. Boiled down to its essence, the problem becomes one of finding the pavement which will, like other structures, give the best service for the least cost. Realizing this, the councilman and the property owner, faced for the first time with the necessity for choosing between the multitude of available types throws up his hands and cries, "What is the best kind of pavement?" The answer, however, helps him little, because it is a fact that, while there may be several pavements which will all give approximately equal satisfaction under the conditions at hand, there absolutely is no best type applicable to all cases.

In the comparison of cost data it

should be remembered that many factors enter into the formulation of a bid price. In the absence of competition, prices soar; upon a small job, overhead costs increase, and with local materials conveniently available, lower costs of the constituent aggregates of the pavement should react in favor of the city.

Is Maintenance Clause in Contract Out of Date?

In most cases, the contractor is required, by terms of his agreement with the city, to maintain his pavement in good condition for a period of five years following completion. The theory is that the contractor will do his utmost to guard against the danger of slipshod and careless work. In the days when comparatively little was known of paving materials and methods and when skilled and reputable contractors were scarce, this plan of safeguarding the public's interests was probably justified. At the present, however, the inclusion of the maintenance clause is of doubtful expediency, except perhaps when new and unproved types of pavement are adopted. An incongruous situation is developed when, as is usually the case, the contractor is asked to guarantee the success of work constructed in accordance with the engineer's rather strict specifications, and particularly so when rigid city inspection is also provided to regulate the many details of the work. This latter seems most decidedly to be the more logical and better form of protection, but it certainly must be intelligently applied if satisfactory results may be obtained. A properly laid pavement should require but little outlay for the period of the guarantee and a pavement which does require extensive patching will almost certainly deteriorate at an accelerated rate immediately after the repairs are completed and will be a bad investment. Thus, why not abide by carefully drawn specifications enforced by good inspection and save in first cost the guarantee charge of 5 cts per sq. yd., which the contractor must charge in self-protection?

The durability of the pavement type is a most important factor in its selection. Without exception, everyone of the pavements at present in use in Texas has at some time or other failed to give the service expected of it, but generally such examples of short life are traceable to defects in construction, lack of maintenance or other preventable cause. Occasionally, however, a type may clearly be incapable of withstanding the conditions to which it is subjected. Sheet asphalt and asphaltic concrete will deteriorate rapidly if not subjected to traffic and will behave most satisfactorily when constantly exposed to the action of rubber-tired vehicles. Wood block has repeatedly been found to give the best service under heavy traffic. Bituminous types, such as asphaltic concrete with stone particles in their surfaces unprotected by a bituminous mortar, will, unless the stone is extremely tough, and the traffic very light, show excessive wear after the first few years of use.

Sometimes the harassed taxpayer, when faced with the immediate possibility of a paving assessment inquires regarding the permanent highways of which he has read so much. Perhaps, too, if he is a student of history, he may remark with feeling that the Appian Way, built by the Romans, has lasted for some two thousand odd years, and that the pavements of other ancient peoples are still in existence. These old pavements certainly are in existence, to the credit of the old road builders, but it is true also that they have never been subjected to modern traffic. Also they were built of solid masonry, sometimes several feet thick, and recent rough estimates have developed the fact that it would cost something like $250,000 per mile to reproduce the famous Appian Way under present costs and conditions. No wonder these highways lasted 2,000 years; and no wonder we do not imitate them.

Placed under an environment to which they are suited, however, brick, sheet asphalt, Warrenite-bitulithic, concrete, and the other standard types should give 10 to 25 years of economical service—if properly cared for.

Pavement Characteristics

Several pavement characteristics sometimes listed separately may be included under the term of general suitability. Ease of cleaning, low tractive resistance, non-slipperiness and noiselessness, may be grouped under this head. Possibly the vertical fibre brick with asphalt-filled joints is least easy to clean, and wood block and sheet asphalt may be regarded as the most slippery, especially when damp and slightly dirty. All of the types offer very low resistance to loads hauled over them and are about of equal desirability upon this count.

Wood block and the asphaltic types are the most quiet and concrete is the most noisy.

In these days of intensive street improvements with attendant high prices it behooves the city official to make use of every possible expedient to stretch available funds to the absolute limit consistent with approved practice. Every resource peculiar to his vicinity should be employed to the utmost and, while construction suited to the situation at hand is adopted, it should be borne in mind that certain types may be extravagantly uneconomical. In selecting pavements it is an excellent expedient for the city to look about and locate, if possible, local sources of material supply. A consideration of present freight rates makes the importance of such a find self-evident. The discovery of a gravel deposit may make concrete the logical selection for the city's pavements. A pit of fine sand, entirely unsuited for concrete may be found satisfactory for any one of several asphaltic types. It may be suggested, too, that an asphaltic concrete upon a good gravel base is a type not to be despised for many of the lighter traffic thoroughfares. Many cities are investigating their local resources to marked advantage and it is a practice which should be generally adopted.

Perhaps, also, types other than those backed by strong promotion organizations should sometimes be employed. Of course gravel for outlying sections is commonly laid, but for other situations justifying greater expenditures ordinary water-bound macadam treated periodically with a road oil may give satisfactory service over considerable period. Bituminous macadam, better known, perhaps, as penetration macadam, should also receive attention for smaller towns or for lighter traffic streets of larger towns. Less expensive than the high-class types generally considered as standard, it should nevertheless give long years of service under conditions to which it is adapted.

At the A. & M. College, a street known as Military Walk was paved with asphaltic penetration macadam some 7 or 8 years ago. This pavement is but 5 ins. thick, including both crushed stone foundation and wearing surface, yet with the exception of a single thin application of asphalt and sand, delayed unfortunately, two years too long, it has given the best of service. True, the pavement is subjected to light traffic—perhaps a hundred vehicles a day and four thousand cadets—but many of our city streets lined with fine residences carry little, if any, more.

What has already been said deals with the selection of pavement types based upon engineering principles, but there is one other factor which in many instances outweighs all of these. This factor is promotion. Certain interests, in fact all of those promoting the standard types of paving, repeatedly mentioned heretofore, have expended much time and money in research and in the development of their materials. We owe them a great debt of gratitude for this, for however much they may profit from it financially, the public is benefited to a far greater degree. For instance, the Portland Cement Association has established a research laboratory and employs one of the country's recognized concrete experts and a corps of assistants to find out all there is to know about concrete. The Warren Brothers Company maintains laboratories where not only are developments worked out, but periodic samples from every bitulithic job are tested. The Asphalt Association and the National Paving Brick Manufacturers' Association are doing similar work with the result that new knowledge is constantly becoming available. Reduced to fundamentals, however, street paving is an engineering operation and an attempt has been made in this paper to outline a few points in proof of the claim that the selection of type must be based upon careful analysis of local resources and environments, if economy and service are to result. The engineer is trained to such analysis and he should be allowed to make it uninfluenced by those who, admittedly unskilled in paving matters, may have been thoroughly convinced of the superior merit of a particular type.

The Highway Engineering Division of the A. and M. College frequently receives letters from anxious public officials requesting a frank statement of the relative value of two or more standard types of pavement. The answer in all cases is and must be the same, namely, put your problem in the hands of a competent paving engineer, let him investigate and make the selection in the light of local conditions, for there is no "best type of pavement."

The foregoing discussion is from a

paper presented before the recent annual meeting of the League of Texas Municipalities.

FUTURE OF ZONING AS BASED ON EXPERIENCE TO DATE

By Albert Lee Stephens, Judge Superior Court, President California State Planning Association, Member Planning Board, Los Angeles, Calif.

What have we accomplished in the less than a score of years of legal zoning? First: We have found out that a law which intelligently, reasonably and nonarbitrarily restricts the use of privately owned real property is necessary to protect real property from irreparable damage. Second: We have indisputably established the fact that there is no constitutional inhibition against such a law. That is all there is to it. Nothing is left but application. But application requires knowledge. Knowledge of the law. Knowledge of human nature. Knowledge of your city. It requires patience, stiff backs as distinguished from stiff necks, love of fairness, honesty. With a mayor, board, city attorney, city engineer thus equipped, the house can be put in order and kept in order.

Of course, you shouldn't wait for these conditions to be perfect before starting. No matter how desirable perfection is, you must get along somehow with something less. Without knowledge of law, you immediately run counter to adverse decisions, because you have been unreasonable or arbitrary. It is easy to see that the courts have affirmed this American doctrine of free use of private property in every practical way by holding that interference by law of the free use use of private real property is possible only where such interference can stand the test of reasonableness and is nonarbitrary in character; otherwise, and most fortunately, the owner may use his property as he wills. The courts construe this doctrine along with that other safeguard: "That one may not use his property to the injury of another."

Early Fears Dissipated

From the beginning of my work along these lines, I feared the doctrine I advocated. I feared that once we unmistakenly gained the right to zone, we would become the victims of bureaucratic orders, directed arbitrarily and without regard to principle. One of the Judges, I think of the Supreme Court of Minnesota, once held, in a dissenting opinion, against all zoning, on the ground that such right would mean the sacrifice of personal liberty more dear to us than the benefits to follow the planning of cities.

Rash Enthusiasm

As a rule, professional city planners, laymen and engineers on planning boards, recently convinced of the benefits of city planning, and some few city attorneys I must add, look contemptuously and unstintingly criticise the courts for what they call old fogyism and nonprogressiveness for pointing limitations. These limitations have not only made zoning possible, but have made it desirable under all the circumstances. And these very same decisions have entirely robbed me of the fears I have alluded to.

Holding Back

The most important work from now on, that will fall to city attorneys in planning and zoning work, will be to hold back and with stiff-backed insistence require that the lines of legality already pointed out by the courts and specially equipped lawyers be followed. I don't mean to hold that we have learned all there is to know, nor that we have reached the end of legal advance. I do mean that the impatient, enthusiastic planner will establish some very objectionable set-back lines, unless the city attorney does his part both wisely and courageously.

Knowledge Requisite

Every zoner must have a thorough knowledge of his city. And every commission should be composed of members from the different geographical districts of the city and from every social division thereof. The city planner should begin his work with not only an acquaintance with his own city of the day, but should know its history and stages of development. He also should know other cities. Cities, like men that compose them, are much alike essentially, but very different in particular parts. Your consultant, if a local man, should have a broader vision than the twenty-mile radius from the County Court House. If an imported man, don't go off satisfied with his doing the job. If you do, you will probably have an ill-fitting suit made after the particular fad of your consultant (all specialists are somewhere and in some manner faddists), or you will have a ready-made affair, made to the measure of another town. Notwithstanding these remarks, I am strongly inclined to the imported article. The adage that

"A prophet is not without honor except in his own country" holds good here. Every phase of planning requires patience. The tendency to hurry to get something is one of the greatest dangers.

Early Los Angeles Experience

Well do I remember the first meeting of the Los Angeles Board of 51 citizens. Almost before organization, the chair announced that the secretary would read a communication from the city council. It ran something like this: "Honorable Members Planning Board: We hereby refer to your honorable board, the question of whether or not lot—etc. (describing the lot) shall be zoned for an undertaking establishment." Com. Blank jumps to his feet, "Mr. President, I am personally familiar with the locality mentioned. This board should immediately become a factor in the city government. I move you that the secretary be directed to address the honorable city council, and to say that this board unanimously disapproves of the request to put this lot in the undertaking zone." I was frightened. I arose and under the personal privilege asked how many such communications graced our secretary's desk. There were several. The board, by big majority, was feverishly desirous of doing something right off the bat. I took the lawyer's risk of being accused of causing delay and of being technical, cautioned against precipitous action before formal investigation. Said it was my idea that we should study the whole city thoroughly; take a year at it before we could undertake the responsibilities of zoning, and then take in the whole city or some natural division of it in one comprehensive ordinance. This was not popular doctrine, but I wasn't booed, so I ventured further: Suggested that we may as well here and now adjourn sine die as to become the willing goats, the official passees of the political buck. That evening, after a long fight through the help of others who saw the danger early, the fight was won. Through the motion, if I remember right, of the member who made the first motion, the council's request for zoning help was declined in a diplomatic note.

I relate this merely as an illustration of what will take place in other localities. Our board soon got down to hard work with patience, courage and courtesy to everybody, including Mr. Well Known Citizen who comes in with not only helpful suggestions but with some special favor to ask, and many times the unwilling tool of veiled interests. It should be borne strongly in mind through all preliminary zoning work that public confidence through frank actions and intelligent educational work is absolutely necessary.

Things to Avoid

Zoning experience is now broad enough for us to mark some of the failures and to avoid them. When zoning first developed it was by the piecemeal method. And the continued use of this method by a few cities is zoning's greatest danger. To be legally privileged to go ahead with any use of any lot in town unless or until the legislative body interferes, offends against every tenet of zoning. Proper zoning stabilizes. This method unstabilizes. No man knows whether or not he can use his property until he attempts to use it and after he has financed and planned his improvement. Then the council or board zones his right away. Some other neighborhood of the same character but without an objecting citizen, is used for the same purpose within the law. Here is discrimination with a vengeance. Here also, is the finest field for political reward and punishment. Here also, is the making of graft.

Western cities are growing, changing, forming. Financial interests are looking to our cities from San Diego to Eureka for investment (both inclusive). A group of Eastern financiers, we will say, wish to purchase a city block in San Diego for an industrial enterprise. They select a site; are advised that everything is all right. Preliminary work is done. The money is paid when, what ho! Some citizen petitions the council. Requests a zone ordinance denying the use of this property for the intended use. The intests face a lawsuit and opposition, when they thought they had city co-operation. Do they under these circumstances retain their enthusiasm? Do they buy another site where the process may be repeated on them after disposing of the original one? Do they advise other industries to come to San Diego? The answer is obvious.

Then there is the fellow who rises to remark that Western cities are growing. "Then would you mould your cities according to some board's idea of development, or would you let them freely develop?" I hear him with that conclusive "I've got you" tone, and he surely has if we don't watch out, for that question has in it a danger that we must avoid. And there is no possible alibi if we do not avoid it. At this day, no student of zoning is without knowledge that

zoning must have ample provision for flexibility and change when circumstances indicate its desirability. And without the knowledge that one of the cardinal rules of zoning is that you cannot zone ahead of the tendency already shown by the district development. original kinds of development. It only shall not be spoiled for that kind of use, by allowing another sporadic use that is fatal to it. Anr then there is always that stop, look and listen sign before every city planner or zoner. For no matter how greatly zoning always does add to the beauty of a city, zoning is never based upon aesthetics, but is always related to the public health, safety, morals and general welfare.

The foregoing matter is from an address before the recent annual convention of the League of California Municipalities.

OBSERVATIONS ON REFUSE DISPOSAL IN EUROPE

By George W. Fuller, Consulting Engineer, 170 Broadway, New York, N. Y.

The collection and disposal of solid refuse in England show departures at present from pre-war practice. During the war much attention was given to methods of salvage. But since the fall in prices of salvaged material in 1920 this has been a less conspicuous factor. However, it is effectively carried out at some places, particularly Birmingham, where all activity pertaining to the collection and disposal of solid refuse comes under a Salvage Department. Its superintendnet, Mr. Jas. Jackson, is about midway on a seven years' program of thorough reorganization. For this purpose he carries on his staff ten men who devote themselves solely to organization methods. More will be said beyond about betterments at this city.

British Practice

Cleansing is the name usually applied to the collecting and disposal of solid refuse In some cities it includes the cleaning of catch basins, cleaning and watering of streets, snow removal, etc. The heads are called cleansing superintendents. Some 25 years ago they formed in Great Britain an Institute of Cleansing Superintendents, which publishes monthly the papers and discussions at its Annual Conferences and at meetings of Local Branches.

At the Aberdeen meeting last June were several instructive papers, including a plea for accurate records of quantities and of cost data on a tonnage basis, with essential particulars as to controlling local conditions, by Mr. J. C. Dawes, M. Inst. M. E., who is the chief inspector of public cleansing for the Ministry of Health.

Before any local authority may issue bonds to provide capital for improvements to its arrangements for handling its refuse, it is necessary to apply to the Ministry of Health for its sanction. This is followed by a public hearing which all interested parties are invited to attend, and the approval is forthcoming only after the inspector is satisfied as to the program.

Extent of the Industry

The extent of the public cleansing industry in England and Wales was outlined for 1921 by Mr. Dawes, who gave the urban population as 30,034,385 and the rural population as 7,850,857, a total of 37,885,242. The total annual dry refuse was estimated at 21,270,900 cu. yds. equal to 8,508,384 tons, based on daily yields per 1,000 population for 300 days per year of 1,500 lbs. for urban districts, 2,250 lbs. for mining districts and 1,200 lbs. for rural districts. To handle the refuse requires regularly about 34,000 men, 8,000 horses and 1,600 motor vehicles, besides various equipment at sidings and for transporting the refuse from such. The value of plant and equipment is over 5,000,000 pounds sterling. Public cleansing, including street cleansing and watering, cost for the year 1920-21 12,494,549 pounds, and of this sum the amount for the collection and disposal of solid house and trade waste, including 236,570 pounds for loan charges, was 8,304,549 pounds, of which 464,775 pounds was recovered from the sale of treated refuse, by-products, etc. This total cost of cleansing is about one-seventh of the cost of all municipal services, omitting schools, police and relief of the poor.

Character of Refuse

British refuse, as in all countries, varies considerably, depending chiefly upon the different uses of coal. A representative analysis as estimated by Mr. Dawes, is for ash and fine dust, 45 percent; cinders of all sizes, 35-40 percent; vegetable matter. 5-10 percent; paper and light debris, 4 percent; metals, 1-15 percent; bone, 0.3 percent, and glass, brick and heavy debris, 12 percent. The British collect mixed refuse and do not deal separately with organic matter except as it comes direct from markets. They do not use the American expression of garbage,

as applied to kitchen refuse other than from ranges, but speak of vegetable mat ter or putrescible matter or organic matter.

During and since the war householders have been urged to lessen their output of refuse. This is largely in the interests of economy, although those in authority clearly recognize that public cleansing is primarily a public health function, and that the ultimate result must be on a higher rather than a lower plane of performance.

Reducing Quantity of Refuse

Suitable publicity is an effective step in lessening the quantity of refuse and in other ways. Its use has been systematically sought in the course of the modernizing of the department at Birmingham, where the collecting wagons have painted on their sides, "Burn More Refuse." The collectors distribute placards to be hung in each kitchen, urging the screening of cinders from ashes and the burning of vegetable refuse in the kitchen fire, as well as the burying in the garden, or the burning of garden refuse. Methods and results are explained by lectures with lantern slides, visits to the disposal works by school children and others are encouraged, and in the central office are window displays exhibiting the activities of the department.

The disposal of the mixed British refuse with its high content of ash and cinders and its low content of organic matter is quite a different undertaking than the disposal of American garbage, practically unmixed with inorganic matter. However, the mixed refuse of some of the Northern, but not Southern cities, in this country is quite like the British product. There is no standard British practice, as the best method of disposal depends upon several local conditions, which frequently vary uuch in different communities. In many districts the selection of the method, within certain limits, is of far less importance than is the efficiency of the management of the department.

In many, if not most, British cities there is real need for better results than are now obtained. Economy is one element of this situation. But it should not be inferred that refuse disposal in Great Britain is free of serious complaint in practically every community; notwithstanding that, within the limits of my observations, the accomplishments there are substantially better than at corresponding cities in America, generally speaking.

There are six methods in quite general use for the disposal of mixed refuse in Great Britain:

1. Tipping or dumping on land where the management is inadequate for securing freedom uniformly from flies, rats, wind-blown papers or objectionable smells, especially from fires which, on account of the large quantity of combustible material in the refuse, sometimes burn for months in spite of efforts to extinguish them.

2. Tipping or dumping on land, in conformity with precautions set forth by the Ministry of Health in its circular of July 26, 1922, as given beyond.

3. Dumping at sea where the barging distance is reasonably short to locations where suitable tides and currents convey the material seaward, and not landward. It is understood that this is practiced only at Southampton and a few northerly cities on the east coast.

4. Burning in high temperature incinerators which the British call destructors, notwithstanding that the burnt refuse leaves perhaps half of its bulk as clinker. In some, but not all places this may be readily disposed of after crushing and screening, for use in road-building or for making concrete, or in some places for brickmaking. Electric current generated at destructors now finds a market through charging the batteries of motor vehicles used in collecting the refuse.

5. Separation from the refuse of the fine dust and ashes by means of revolving screens, and also of the coarser debris, thus leaving the cinders and vegetable matter which are incinerated. This arrangement is briefly explained beyond, as it will be carried out at the new Brook Vale destructor, now approaching completion at Birmingham.

6. Crushing of the mixed refuse, after freeing it of coarse debris, and utilizing the pulverized product as a fertilizer for clay or loam lands. This product is also well suited for filling low lands. The fine material screened from cinders in Method 5 is similarly handled, while in Scotland much refuse is sent to farmers with little or no use of mechanical appliances for its preparation.

Gas Production

The above methods are not intended to be a complete list, but are used as a convenience to expiain the state of the art as I found it. Perhaps mention should be made of the use of refuse by Ashwell and Nesbit, Leicester, to produce gas on the lines of the producer gas plant. Reference certainly should be made to the

work of Mr. W. Weaver, Chief Chemist to the Salvage Department of Birmingham, who read an excellent paper at the Aberdeen Conference, describing his use of the Iwel melters and dryers for making poultry feed or fertilizer from market and slaughter house wastes; purification of oils; de-tinning; analyses of ash, clinker, etc., and various means by which the chemist can aid a Cleansing Department.

Suggested Precautions

Many British refuse dumps are sources of complaint, and to improve matters the Ministry of Health on July 26, 1922, issued "Suggested Precautions," which are given in full below, but subject to review in each case as to figures stated, as follows:

"1. Every person who forms a deposit of filth, dust, ashes or rubbish, of such a nature as is likely to give rise to nuisance, exceeding 100 cu. yds., must, in addition to the observance of any other requirements which are applicable, comply with the following rules:

"(a) The deposit to be made in layers.

"(b) No layer to exceed 6 ft. in depth.

"(c) Each layer to be covered, on all surfaces exposed to the air, with at least 9 in. of earth or other suitable substance; provided that during the formation of any layer not more than 50 to 100 sq. yds. may be left uncovered at any one time.

"(d) No refuse to be left uncovered for more than 72 hours from the time of deposit.

"(e) Sufficient screens or other suitable apparatus to be provided, where necessary, to prevent any paper or other debris from being blown by the wind away from the place of deposit.

"2. Every person who deposits any filth, dust, ashes or rubbish likely to cause a nuisance if deposited in any water must, so far as practicable, avoid its being deposited in water.

"3. Every person who deposits any filth, dust, ashes or rubbish must take all reasonable precautions to prevent the breaking out of fires and the breeding of flies and vermin on or in such deposit.

"4. If the material deposited at any one time consists entirely or mainly of fish, animal or other organic refuse, the person making such deposit must forthwith cover it with earth or other equally suitable substance at least 2 ft. in depth.

"5. Every person who deposits any filth, dust, ashes or rubbish must take all practicable steps to secure that tins or other vessels, or loose debris likely to give rise to nuisance are not deposited in an exposed condition on or about the place of deposit.

"6. Sufficient and competent labor must be provided in connection with the deposit to enable the necessary measures to be taken for the prevention of nuisance.

"7. So far as practicable each layer of refuse which has been laid and covered with soil must be allowed to settle before the next layer is added.

"8. Wherever practicable the person making the deposit must avoid raising the surface of the tip above the general level of the adjoining ground.

"9. All refuse must be disposed of with such dispatch and be so protected during transit as to avoid risk of nuisance."

These precautions are founded on the theory that flies do not penetrate a layer of earth more than about 8 in. thick; that odors of decomposition are controlled by absorption by the 90 percent of inorganic refuse and by the cover of earth; and that "spontaneous combustion" of the refuse is prevented by the earth cover excluding the air needed for combustion.

Filling Quarry Holes

At Bradford I found that the city refuse seemed to be disposed of quite satisfactorily by dumping under careful management in 46 quarry holes scattered about in a city of about 270,000 population. Mr. Call, superintendent, prides himself upon the success with which he has made from former holes attractive parks, playgrounds and gardens, and at a cost for disposal of refuse of only one shilling per ton, besides keeping the collection cost at a low figure on account of the short haul to the numerous tips. At the time of my visit he had started the filling of a large quarry hole adjacent to a large hospital. He takes unusual care to assemble papers and put them in an excavation and cover them so as to prevent their blowing around, and also to put all tins upright and fill them with refuse so as to lessen channels which rats might enter.

Attention is directed to a comparison of the one shilling per ton cost of carefully supervised tipping at Bradford with the ordinary cost of incineration which, of course, varies with the size and arrangement of the destructor plant, but which usually is from 8 to 10 shillings per ton.

Screening

At the new 200-ton Brook Vale Destructor at Birmingham, Mr. Jackson will first remove by screening the ash and dust

which form about 40 per cent of the total refuse. This he will dispose of to farmers whom he expects to pay several shillings per ton. In any event the destructor is freed of 40 per cent of its load, and the most unsituable portion for burning. Operating expenses will thus be spared the cost of say 6 shillings per ton for handling this ash and dust, regardless of the proceeds from its sale. This leaves the destructor to operate upon the cinder and organic matter, which purpose it best serves both from the public health standpoint and as regards power production. Furthermore, the elimination of the dust and ash increases the capacity of the destructor when expressed with reference to the population served by destructor units of a given size.

The arrangement of this plant, which goes into service shortly, is worthy of comment. Briefly, the refuse arrives in motor vehicles on the top of a high ramp, beneath which is a two-story garage for the storage of the vehicles and the charging of their batteries with current produced by the plant. The refuse is tipped into one of three 10-ton concrete hoppers, with sides having steep slopes and at the bottom is a moving metal belt, like a stoker grate, for discharging on to a revolving screen. It is the intent to have not more than 10 shovelfuls at a time on an inclined screen, say 4 ft. in diameter and 10 ft. long, with ⅜-in. openings. The removed ash and dust goes to motor trucks or canal barges, leaving the cinder, which at some places has 10,000 B. T. U. per lb. At the lower end of each screen are several magnets for removing metals from the screened refuse before its discharge on to a moving sorting belt for hand removal of glass, bones and heavy debris. The top of this belt passes under a hood, where it is expected to remove paper by suction. The cells will be hand stoked from the top with material discharged from the sorting belt or from a tip which may be used if it is not desired to screen some portions of the refuse. Clinker will be removed from the rear of the cells. The building, with very complete equipment, has been erected by Heenan & Froude.

The ash and dust has been removed by screening at Glasgow, Sheffield and other places, including two of the older plants at Birmingham, where analyses show it to contain 0.9 nitrogen and 3620 B. T. U., with some potash and phosphoric acid. Analyses elsewhere show that it frequently contains from 0.7 to 0.5 percent or less of nitrogen. However, the Ministry of Agriculture has been investigating refuse and finds that applications of refuse at the rate of 10 tons per acre have proved very useful on heavy clay lands for root crops, cabbage, etc., and that a farmer is justified in paying some money to obtain this result. Compared with 12 shillings per ton for stable manure delivered on the farm, it is stated that town refuse would be worth 6 shillings per ton on the farm, and more if the nitrogen content exceeded 0.6 per cent.

Disposal on Farm Lands

Many of the larger towns of Scotland dispose of much of their refuse for use on clay farm lands, the amount approximating 163,000 tons annually, according to Mr. Asher, Cleansing Superintendent at Perth. At his own city the demand exceeds the supply at 2 shillings per ton f. o. b. at the city siding. He has the rubbish picked from the refuse, which is then allowed to get set, after which it is trenched on top and well watered. This sets up a heat which aids in rotting the paper and vegetable matter. No material is shipped until it has lain at least three months when it has become a black mass, easily handled and not likely to cause serious nuisance.

In England the preparation of refuse for agricultural purposes is being aided at some places by pulverizing it, rather than by screening.

On the Continent

On the continent, destructors are in use at many prominent cities, including Paris, Nancy, Marseilles, Brussels, Rotterdam, Amsterdam, Cologne, Hamburg and Berlin. But at Frankfurt I found that the destructor plant has not been operated since August, 1920, owing to the cost exceeding that of disposal on land. A similar step is being considered at Zurich, where the plant is very fully equipped with mechanical appliances intended to save operating costs.

At Florence I visited the Becarri plant which deals with the mixed refuse of about 100,000 population, together with some stable manure. The refuse is first freed of most of the heavy debris and rubbish by hand picking. There are 154 concrete cells, each about 20 cu. meters capacity, approximately cubical in form, and provided with a ventilating tower in which are trays of earth and sulphate of iron. At the bottom are grids over channels leading to a sump, and in each corner is a vertical iron air duct, with outside connections and also with inside connections with several fillets which ex-

tend horizontally around the inner walls of the cells.

The sorted refuse is placed in a cell, wet with water if need be, and allowed to ferment for about 45 days, including the cooling period. I examined cells where the contents had been fermenting between 10 and 15 days. The interior was very hot, with many patches of white molds, and generally resembled farm yard manure in process of rotting. The final product closely resembles humus, and is screened from coarser particles, some of which are put into a cell for a second time. It is said to be a good fertilizer and to sell for 40 to 50 lira per 100 kilos, or about 10 times the price of stable manure rotted in open pits.

I found no signs of odor or of flies at the cells or in the shed where the fermented product was being screened. There were some flies and smells around piles of unfermented refuse awaiting treatment.

The foregoing paper by Mr. Fuller was presented before the Sanitary Engineering Section of the American Public Health Association at Boston on Oct. 9, 1923.

PRESENT STATUS OF THE STEAM RAILWAYS

By J. D. McCartney, Assistant to the President, Central of Georgia Railway Co., Savannah, Ga.

The transportation problem, though it has many phases, may be summed up in two words, "efficient service." Amplified a bit, that phrase means the securing and maintaining of railroad systems that will, with reasonable promptitude and reasonable safety, carry the commodities from the places of production to the places of use or consumption, at the lowest possible charge for the service.

The record of the railways for the first ten months of 1923 affords ample proof of the competency of railway management. But competency alone is not sufficient to make railroad facilities adequate. If transportation is to keep pace with the business demands of the nation, it must have both competent management and large expenditures of money annually for a long period.

America's capacity for production is measured by America's facilities for transportation. Resources may be inexhaustible, but commodities will not be produced unless they can be moved to the markets of the country. Every branch of industry and commerce has, therefore, keen and vital interest in adequate transportation.

1923 Freight Traffic Greatest in History

The railroads have made good on their pledge of last April to meet the unprecedented demand for transportation this year. Although the amount of freight traffic offered has been the largest in history and much greater than was anticipated, the railroads have moved it promptly and efficiently.

It was predicted last spring that railway freight traffic would reach new high levels during the summer and fall. In preparation for the task of moving this record traffic, the railroads announced a program of expenditures upon additions and betterments to their properties amounting to more than $1,100,000,000 for the year. They set out to reduce the number of freight cars needing repairs to 5 per cent of the total and the number of locomotives needing heavy repairs to 15 per cent of the total. They agreed to lay in surplus stocks of coal during the summer, in order to release equipment for other use later in the year. They agreed to carry forward their construction and maintenance programs to have as much work as possible completed by Sept. 1.

New Equipment

All of these objectives have been substantially attained. For example, between Jan. 1 and Oct. 1 the railroads installed 134,636 new freight cars and 2,963 new locomotives, and on the latter date they had on order, with the deliveries being made daily, 64,601 new freight cars and 1,242 new locomotives. On Oct. 1 the railroads had in reserve 17,663,448 tons of coal, as compared with 6,756,886 tons on Jan. 1..

The surpassing achievement of the year is that a traffic greater than has ever before been known has been moved without interruption or delay. It was anticipated that car loadings would exceed a million cars a week in 9 weeks prior to Oct. 1. In reality, car loadings exceeded the million mark in 15 weeks. In the week immediately prior to October 1 more cars were loaded with freight than ever before in railway history—a total of 1,092,567 cars. Prior to 1923 the record loading was 1,018,539 cars in the week of Oct. 15, 1920. Loadings in the nine months up to Oct. 1, 1923, amounted to 37,308,891 cars, an increase of 19 per cent over the first nine months of 1922, 28 per

cent over the first nine months of 1921, and 10 per cent over the first nine months of 1920. However, it is feared that, even with this unprecedented volume of traffic, the railroads will fail to earn for the year the 5¾ per cent upon their tentative valuation to which the Interstate Commerce Commission has held they are entitled.

A Splendid Performance

The railroads, their employes and their patrons are to be congratulated upon their splendid performance in handling this record traffic. There may be some danger, however, that this great achievement of the railroads will create the false impression that a further increase in railway facilities is not needed. To be able to meet the future demand for transportation as they have met it this year, the railroads must not rest upon their oars; they must continue to extend and improve their facilities. Funds must be obtained to provide the additional facilities necessary to reduce the costs of operation and to enable the railroads to furnish the public adequate transportation at the lowest possible rates. Railway patrons must realize that this requires that railway credit be maintained.

At a previous time when business was on the increase, the development of our railroads was arrested through a loss of credit occasioned by shrunken earnings and the growth of restrictive regulation. It must be remembered that the railroads are owned by something like 800,000 persons, holders of their capital stock. The number of persons who have lent money to the stockholders by purchasing railway bonds and thereby accepting a prior claim upon the earnings of the properties owned by the stockholders is approximately as great as the number of persons owning stock. This makes something more than one and one-half million individuals who have a direct financial interest in railway earnings. All of us have an indirect financial interest, for we are all dependent upon the maintenance of adequate transportation, and adequate transportation can not be maintained without adequate earnings.

Railway Credit Improving

When money must be had for expenditures upon extensions and improvements to the railway plant, and it is not available from earnings, it has to be obtained through the sale of additional securities, either to present stock and bondholders or to other persons. Until the passage of the Transportation Act in 1920, owners of railway securities had not fared very well, and that made it difficult to raise new capital for extensions and improvements. This year, however, railway credit has been improving materially. This has been largely because of the optimistic, forward-looking attitude taken by the railway managements of the country in the face of inadequate earnings. Such an attitude is based largely upon the Transportation Act, which pledges the country to give the railroads a square deal. Thus far railway earnings, while on the mend, have not reached the 5¾ per cent designated by the Interstate Commerce Commission as a fair return. For the thirty-five months under the Transportation Act up to Aug. 1, 1923, railway earnings have been at the annual rate of 3.97 per cent upon their tentative valuation. For the first eight months of 1923, the railroads realized a net operating income of 5.4 per cent upon their tentative valuation, as compared with 4.46 per cent for the first seven months of 1922. With business good and rates unchanged there is hope that the railroads will have a fairly good year, and that hope has served to restore some of the old-time confidence in the security of railway investments. Expenditures upon the railway plant this year will exceed one billion dollars, more than twice the average prevailing in the last several years. About 60 per cent of the sum is being spent for new locomotives and cars; the other 40 per cent is being spent for better and more adequate roadway facilities and structures.

Billion Expended on Railway Plant This Year

The progress that the railroads have made in the improvement of their properties is something to be proud of. It proves that there are men and women in this country who have enough faith in the future of the country and the soundness of its institutions to put up, in one year, around one billion dollars for railway investments despite the meager earnings that the railroads have been allowed to realize. With such confidence as this in the future of the railroads, many of which only a short time ago were taking heavy losses and passing up dividend payments, surely any business which may be suffering temporarily ought to take heart and hold on.

The Threat of Radical Legislation

If it were not for the constant threat

of radical legislation, the country could rely upon a continuance of satisfactory railway service and upon the likelihood of constantly increasing investments being made in extensions and improvements to the railroads. The only thing that can stop the ambitious plans of the railroads to expand in keeping with the growth of the country and of its commerce is the unconstructive legislation of the radicals who are striving with all their might to bring about government ownership of the railroads by making it impossible for the railroads to be operated successfully under private management.

Government ownership of our railroads would be a national disaster. The very fact that the maintenance of good railway transportation means so much to the welfare of the country is reason enough for us not to give up the system of private management that has given us the most efficient, most economical railway transportation in the world.

Our government now has all the power of railway regulation needed to safeguard the interests of the public; government ownership would add nothing in protection, and it would subtract the incentive which now exists under private management to operate the railroads efficiently and economically.

American and Foreign Railways Compared

There are a good many Americans who do not fully realize the tremendous dependence that the United States must place in strong, efficient railroads to maintain the commercial supremacy we have attained. Not until the railroads of other countries are compared with ours and we realize what it means for us to have efficient, economical transportation that has been developed in this country under private management do we see how inextricably the prosperity of the country is bound up with its transportation. Our nation has been extremely fortunate in the development of railway transportation. The remarkable growth that we have had in the lifetime of men still living can be traced directly to the rapidity with which railroads were built and developed, and our prosperity as a nation today is inseparably linked with the maintenance of adequate, efficient transportation.

For the most part our railroads have ignored state lines, and to that extent they have helped to weld us into a united nation. In Europe, on the other hand, most of the railroads were developed as military exigencies required; they ended at the borders of their respective countries, and frequently they were of varying gauges, so that the enemy might not readily use them as a means of invasion. The result has been the fostering of intense nationalism within restricted areas, lack of understanding, commerce of comparatively small proportions, and much of the economic and political trouble to which modern European nations are heir.

In Europe, moreover, there has not been developed to the extent known in this country the practice of territorial specialization in agriculture and manufacturing. In the United States hundreds of miles frequently separate the farm from the packinghouse, factory or mill where farm products are prepared for consumption, and frequently hundreds of miles separate the packinghouse, factory or mill from the consumer who eventually pays for and uses the manufactured product. Transportation has become such a common and dependable thing that it has created a commercial development unlike that at present obtaining in Europe. There are few localities in our country that are self-supporting, and the reason for that is the quality and comparative cheapness of American railway transportation.

Modern transportation is an important part of every form of business. Without it, there could be no farming on the scale that farming is practiced nowadays, no manufacturing in great quantities and at low cost, no distribution of manufactured goods over great areas and to millions of people. Destroy the railroads, and the production of goods would necessarily be limited to the demand of the immediately surrounding territory. It would set the country back nearly one hundred years, for all the development that has occurred since the building of railroads began has gone along with the railroads.

Constructive National Regulation Favored

The railroads frankly invite the fullest inquiry into their methods, resources, earnings, purposes and accomplishments. They have nothing to conceal. They would gladly welcome a universal public understanding of what they are doing and hope to do, how they are doing it, and the difficulties they encounter meanwhile. The railroads favor a system of national regulation. They only stipulate that such regulation should be constructive and not destructive, directive rather

than restrictive. Its aim should be economic, not political supervision.

Faith in the American spirit of the square deal justifies railway management in the determination to provide the service that the country needs, and to make generous plans for the future.

The foregoing address by Mr. McCartney was delivered at the recent annual meeting of the American Society for Municipal Improvements.

ADEQUATE AND EQUITABLE HIGHWAY FINANCING

By R. M. Hubbard, Chairman, State Road Department of Texas, Austin, Tex.

The steadily increasing demand for more and better highways arising from the increase in motorized traffic during the past few years, has resulted in a financial problem so great as to make it imperative that our method of highway financing must be changed and developed if the necessary road support is to be secured and if serious consequences to the motor vehicle industry, to the taxpayers and the community as a whole are to be avoided. Many students of this problem are beginning to appreciate the importance of the situation, and are devoting their time and energy toward securing a correct analysis of the problem and a sane program of finance.

There appear to be two fundamental questions involved. The first relates to the division of the cost of constructing a system of highways as between the present taxpayer and future generations. To what extent shall the roads be paid for by taxes and to what extent by bonds? The second question relates to the division of the cost as between the user of the road and taxpayers in general. A correct answer to these questions would solve the problems.

It is not the purpose of those charged with the duty of completing a connected system of State highways, to raise the necessary funds for this purpose regardless of the source, but they desire to equitably place the burden on the shoulders of those who receive the benefits of the roads, in direct proportion to such benefits. It will require a combination of engineering knowledge and sound economic analysis, coupled with honest, conscientious study to arrive at an accurate and just solution of this problem.

Certainly the present taxpayers want good roads. They want and deserve as many good roads as are economically justifiable. It is obvious that fewer good roads can be built, if the present generation undertakes to pay the entire cost of all roads built, than if a portion of the cost were met by the proceeds of bonds. The question is just how much of the cost should be charged to the future generation, and bonded in a sound defensible program for roads.

We instinctively dislike large public debts—and rightly so. Few of them leave tangible assets. The public must be shown that there is a permanent asset in good roads, well constructed and properly located. Until this is done public temper will not permit large bond issues for road-building purposes. That there is a permanent asset in a well-constructed and properly located road is fast becoming an admitted fact. This being true, then it is right and just for the future generation to bear part of the cost of construction, for it is axiomatic that each generation should pay its way. Granting this, then it is practically, as well as theoretically correct that any debt which the present generation passes on to the next must be adequately covered by sound assets passed on to that generation. Therefore, the question dwindles down to "What part is considered a permanent asset?"

After the road has been completed and our bond money spent, what do we expect? Not a road that will stay intact and resist the heavy motor traffic and bad weather, year in and year out, without being properly maintained. In fact, we expect the surfacing to wear and wash, but we must not overlook the actual increase in value of the permanent investment as the years go by. In other words, the subgrade is better as it becomes compact, the bridges are improved, the hills are cut, the safety factors are strengthened, and railroad crossings eliminated. Use of the road deteriorates the surface, but only enhances the other factors.

Maintenance of the road after construction is requiring a great deal of study on the part of those charged with the duty of constructing and maintaining the highways. It has been suggested, and the writer endorses the suggestion, that the definition of the word maintenance be extended so as to include not only the day-to-day and year-to-year expense of keeping the highway in serviceable condition, but also to include resurfacing whenever needed. In this way the road would never wear out, but would be

turned over to the next generation unimpaired. A road once built to a given standard would be maintained for all time to that standard, each generation assuming the responsibility for maintaining it during the time it used the road. This would make the life of the road indefinitely long, and such a definition, if adhered to, would destroy the argument against long-term bonds. It would seem just that the users of the roads should pay for the cost of maintenance, including resurfacing and new drainage structures.

In this manner we would be able to raise the necessary sums to build an extensive system of highways without unloading on the present generation of general taxpayers the heavy charge of amortizing highway securities in a 15 to 20-year period. Long-term bonds would compel the succeeding generation to pay its part of the cost of the road passed on to them. The success of this theory would require the writing into the law of stringent requirements as to maintenance and a classification of resurfacing as a maintenance charge.

USING DYNAMITE TO CUT OFF CONCRETE PILES

By A. G. Livingston, Bridge Engineer, Delaware State Highway Department, Dover, Del.

Dumorite was successfully and economically used to cut off excess lengths of concrete piles for a bridge across the Smyrna River, now completed by the Delaware State Highway Department.

The piles are 16 ins. square with four ¾-in. round bars at the corners and four ½-in. round bars on the sides; the ¾-in. bars project above the pile and are imbedded in the pile cap.

Test piles were driven to a length of 37 ft. and the length of concrete pile was determined from the test piles. An average length of 28 ft. was selected; it was, however, somewhat in excess of the required length, and it was decided to cut off the extra length by the use of Dumorite.

The corners of the piles were cut away, exposing the reinforcement for a distance of 3 ft. above the cutoff. This corner reinforcement is 2½ ins. from the face of the concrete. A 1¼-in. hole was then drilled into the piles for a distance of from 8 to 10 ins. at a point 3 ft. above the cutoff line and the hole loaded with 6 ounces of Dumorite. Mud was packed in behind the explosive, the proper fuse having been attached before inserting the Dumorite into the drilled hole. The hole was drilled in about 20 minutes. Usually about nine piles were shot simultaneously. The result after shooting left the concrete between the 3-ft. point and the cutoff elevation in such a crumbled condition that it could easily be taken out with a bar or a chisel and hammer, and in no case was the pile injured in any way below the cutoff line. It was only necessary to refire 3 piles in order more thoroughly to break up the concrete to facilitate its removal.

The sum of $30 represents the total cost of powder and the labor of placing it in the holes, about 40 lbs. of Dumorite being used in the operation, while $285 was the cost for compressor, drilling and removing of the pile broken up by the explosive. This, on a unit basis, is slightly less than $6 per pile.

This bridge is composed of four 18-ft. spans on concrete piles, and is the second of its type to be built by the Highway Department of Delaware.

C. D. Buck is chief engineer of the department, and L. A. Porter was the engineer directly in charge of the work. The contractor was Baton Construction Co. of Philadelphia, Pa.

COMPREHENSIVE MOTOR TRANSPORT SURVEY IN PENNSYLVANIA

Definitely to determine the nature and amount of future traffic that will use Pennsylvania roads, so the pavement may be designed adequately to carry the traffic, the Pennsylvania State Highway Department began a motor transport survey on allimp ortant roads on Nov. 8, 1923. In this survey it is being joined by the United States road department.

"The information gained through this survey will be used in determining the width and thickness of the pavements we will put down," said William H. Connell, Deputy Secretary of Highways and Engineering Executive of the Highway Department. "It is important that in building roads Pennsylvania have as accurate an idea as possible of the traffic which will use those roads. In railroad construction the corporations follow this idea. The telephone corporations and electric railway companies do likewise. There is nothing haphazard in their planning. They know what they are doing before

they do it. That should be—and will be, Pennsylvania's method in the construction of highways. Through it the State will be able to conserve its resources; and at the same time build highways which will carry the loads of the present and of the future—because our study of this problem is primarily an investigation of the probable future development of the country through which the various road sections pass."

This transport survey is the most intensive ever undertaken by any American state or foreign country. It involves the operation of 78-truck weighing stations and over 300 recording stations, distributed over Pennsylvania's primary and secondary highway systems in a manner calculated to give the most accurate estimate of the state's road traffic. The survey will continue for a whole year, it is believed. At the various weighing and otherstat ions there will be signs calling upon traffic to stop, so the traffic recorders can get the necessary information.

"So that our work may be expedited," said Mr. Connell, "we request the cooperation of all automobile operators—not only as to stopping when asked to do so, but as to furnishing information desired."

Motorists will be asked to fill in cards, so the following information may be secured: License number of motor vehicle, width and type of body, manufacturer, capacity (loaded and light); weight.

COMPETITIVE BIDDING BETWEEN ENGINEERS

To the Editor:—

Your editorial in the October issue of Municipal and County Engineering apparently invited further discussion of the question of selecting consulting engineers through what you are pleased to term a "competitive bidding contest" for the purpose of "hammering down the price." For the purpose of inaugurating such a discussion I submit the following thoughts:

1. That healthy competition among engineers is not only legitimate, but desirable, provided the competition is not on such a basis that the fee is cut down below that established by custom and at which the engineer can afford to give his client the best service there is in him and every bit of the attention needed for the successful and economical completion of the work for which his services were engaged.

2. We may find persons who will argue that if competitive bidding among contractors is proper and in the best interests of the owner, which, of course, seems to be the uniformly accepted idea and which, in the case of public works is usually required by law, then there is no reason why similar competition for the services of an engineer is not equally wholesome and advisable. Such persons probably do not stop to see the difference. In the case of contractors, every one is particularly anxious for a certain job and bids low, possibly too low, but he always has the chance by hard work, attention to details and shrewdness in many ways to reduce his costs of completing the work. Furthermore, in bidding, he follows specifications which show him exactly what he has to produce or deliver, and after that it is only a question of handling the work so that it will cost him a minimum amount.

It is different with the professional services of an engineer. In the best interests of his client, the necessity of attempting to cut the cost of his work in order to show a profit on a small fee should never be put up to him. He should be free to give whatever attention the work may from time to time require. While he is presumably under contract with his client to perform certain services, such as preparing plans and specifications, the making of a report or the supervision of construction, such contracts in the very nature of the case, are necessarily in general terms, which practically must leave it entirely to the engineer's conception of the service that any particular piece of work requires.

The engineer therefore should be assured that if he gives his client the kind of service the job demands, his fee will be such that he can afford to give it.

Very truly yours,
ARTHUR S. MILINOWSKI.

Of Druar & Milinowski, Consulting Engineers, Globe Bldg., St. Paul, Minn., Oct. 24, 1923.

A CRITICISM OF THE FORM AND FINANCING OF PUBLIC WORKS CONTRACTS

By W. W. Horner, Chief Engineer of Sewers and Paving, City Hall, St. Louis, Mo.

(Editor's Note: The following paragraphs are from Mr. Horner's presidential address at the recent annual meeting

of the American Society for Municipal Improvements.)

With all its detail studies of the specifications for materials and methods involved in public work, the American Society for Municipal Improvements in the past has given little consideration to the forms of contracts. Apparently only one of our committees, that on specifications for sewers, has had the courage to attempt to include a form of contract with its specifications. The hesitancy in this direction has undoubtedly been due to a feeling that the Society should keep away from matters legal and political. At the present time, however, I know of no phase of municipal work which is subject to so much criticism as is the form of contract in common use. These contracts are extremely unfortunate in at least two particulars; that is, in regard to the "lowest responsible bidder," and with respect to the "requirements for rigid adherence to plans and specifications" and the limitation on the discretion of the contracting officials.

Both of these conditions have undoubtedly grown out of serious abuses in the past, and there is no question but that there is still a very definite need for the municipalities to protect themselves against manipulation and collusion, to a greater extent than occurs in private work. There is still in the air a feeling that the city's money is anybody's money that can get it, and that 50 cents on the dollar is a fair return for the money put in public work. We all know that these are very common opinions in the mind of the average citizen, but we also appreciate that the better organization of the bigger cities, particularly in regard to their Engineering Bureaus, and the growing intelligence as to public affairs, even in small communities, are making these hazards of less importance than the necessity of carrying on the city's business in a business-like way.

I recently had the honor of representing this Society at a meeting of the Board of Directors of the Associated General Contractors of America. The matter of a standardization for contractors of public work was under discussion. I was much interested to learn of the work which had been done in the renovation of the federal contract, and particularly in the suggestion for defining in advance a responsible bidder, and for broadening somewhat the discretion of the engineering executives charged with the supervision of contract work. I took occasion at this time to suggest that following the adoption of the federal contract, the Associated General Contractors should appoint a special committee on municipal contracts, and should call on the American Society for Municipal Improvements to act with them in preparing a standard document. I have no doubt that this work will be undertaken and in anticipation of it feel that we should appoint next year a committee on contracts, which should begin the study of this subject and be prepared to confer when called upon.

Another phase of municipal work which is even more far reaching in its iniquity than some of the so-called unfair stipulations, is the method of payment quite commonly provided. I refer to those contracts which are financed from local assessments, and which constitute a very large part of the business of the cities. It is still the custom in most of the cities of the country to pay in the form of some special tax lien, whether this is called a special tax bill or a local improvement bond makes no particular difference. These bills or bonds are not based on the cities' general credit, but are secured only by a lien on the local property. In some instances they are marketed by the city and payments are made in cash, but in these instances there is sometimes a question as to the sufficiency of funds for the particular project. Where this old system has been retained in its entirety, as it has in St. Louis, there exists hazards to the contractor, and the expense involved in collecting these tax bills on completion, and where the experienced contractor in this line has made proper provisions for these difficulties, then there has been added to the cost of the work a very large item which finally falls on the local property holder. The cost of financing public work in this manner in some cities now amounts to as much as 30 per cent of the actual cost of construction, and is a direct loss to the whole community. The removal of this obsolete system can only be accomplished by public education and the direct influencing of legislation. At my suggestion, the Committee on Municipal Legislation and Finance of the American Society for Municipal Improvements has taken up the study of a standard code governing the financing of local improvements. As this is also a matter which I do not think can be satisfactorily worked out from any one viewpoint, I have during the past year requested the Board of Directors of the Investment Bankers' Association of America and of the Associated General Contractors of

America, to co-operate with us. It is proposed to organize a conference which will prepare a report of recommended practice for local improvement financing, and an accompanying draft of proposed statutes, which can be presented to cities and states for enactment. These Societies can act jointly in the matter of public education and propaganda toward the legislative bodies, to the end that all states may pass enabling legislation permitting the financing of local improvement work on an economical basis.

ARKANSAS DISTRICT SYSTEM OF ROAD BUILDING CALLED UNJUST

In a letter to P. R. Barnes, chairman of the Federal Relations Committee of the State Senate, Secretary of Agriculture Wallace recently condemned emphatically the road district system under which roads have been built in Arkansas in recent years, as an unjust and inequitable system which puts a grossly unfair burden upon farm land adjacent to the highways. At the same time he states that he is not authorized to prescribe the manner in which money shall be raised for road construction in the state. That, according to the Secretary, is for the people of the state to decide and the legislature to work out.

The Secretary's letter is addressed to the Chairman of the Senate Committee and serves as an answer to the scores of petitions he has received from citizens of the state and members of the Legislature, calling upon his to put a stop to the practice of financing road improvement by the special road district plan, which the petitioners claim has resulted in taxation of farm lands so burdensome as to be practically confiscatory. The responsibility for the continuance of the system is squarely upon the shoulders of the people of the state and their representatives in the Legislature.

The government has from the beginning maintained a hands-off policy in respect to the method of raising money in Arkansas, according to Secretary Wallace. He feels that the local district system is wrong in principle, and grossly unfair. He states that this view has been expressed repeatedly throughout the controversy over the situation in Arkansas, but he is not authorized under the law to require the abandonment of the system as a condition of the resumption of federal aid payments.

Under the Federal Highway Act each state submits to the Department of Agriculture a system of interstate and inter-county roads not exceeding 7 per cent of its total public road mileage. Over this system of roads, when constructed, the inter-state, state and inter-county traffic will flow. The system is designed to connect the large centers of population and county seats, thus covering the state with a network of highways for the use of city and town traffic, and for interstate traffic as well as for the benefit of the agricultural population adjacent to the highways. In the view of the Secretary, therefore, the assessments for money to be raised by the state ought to be distributed as widely as possible over all of the people of the state. If, as it appears, this view is widely held in Arkansas, the Secretary expressed the hope that the time may be ripe for the Legislature in the special session called by the Governor to work out a plan of financing the needed road construction and maintenance in a way that will be just to all the people.

PRACTICE IN STREET AND SIDEWALK DESIGN IN VARIOUS CITIES

(Editor's Note: The data given herewith are from the report of the Committee on Street and Sidewalk Design, as submitted at the recent annual convention of the American Society for Municipal Improvements. Mr. E. R. Conant, 168 Winthrop Road, Brookline, Mass., is chairman of the committee. Other members are Messrs. P. L. Brockway, S. Q. Cannon and H. E. Barnes.)

We all recognize the fact that the coordination of vehicles for transportation and the pavement, which carries it, is a deep problem for the engineer to continually work upon. The perfection of the automobile and truck has advanced ahead of pavement construction that will satisfactorily give service to the rapidly increasing volume of automobile and truck traffic.

During a comparatively short period highway officials, consulting engineers, laboratories and various societies and associations have been working upon improved street designs and methods of construction of pavement and eliminating, at least in part, the mistakes and weaknesses of the past. The importance of traffic analysis is being more and more

recognized and, when the amount and character of traffic for a proposed thoroughfare is ascertained, then the foundation is laid for the designing of the type that will meet requirements of traffic conditions and withstand the shocks and use to which it is to be subjected.

The Asphalt Association has collected information, perhaps the first of its nature, showing the amount of municipal paving that has been constructed in cities of the United States. The Association received reports from 209 cities, which included all but three with a population exceeding 10,000, and the tabulation of the replies shows that over 600,000,000 sq. yds. of pavement have been laid which exist today. If this paving was extended in one roadway, 18 ft. wide, it would have a length of nearly 57,000 miles. Of the total pavement reported, 78 per cent is of a type of construction higher than water-bound macadam. When subdivided, 54 per cent is of asphalt or bituminous type, 22 per cent brick, 12 per cent stone block, 3 per cent wood block, 5 per cent Portland cement, 2 per cent tar macadam, and 2 per cent miscellaneous.

Radii of Curb at Street and Lane Intersections

That municipal and other engineers are recognizing the advantage gained with long radius corners is shown by the replies received to our questionnaire sent to many cities, which indicate that a decided reaction has set in of late as regards adoption of the radii length.

Hartford, Conn., reports changing from 6 ft. to 12 ft. and 15 ft., and states a great improvement is noticeable with this change.

Waterloo, Iowa, originally had 10 ft.; a few years ago changed to 15 ft., is now adopting 30 ft., and this year changed some dozen street intersections to meet new requirements.

Toronto, Canada, had originally 12 ft., then changed to 18 ft. and now has adopted 25 ft.

Los Angeles reports that it uses a radius at curb corners equal to the width between the curb and property line, except where the distance on both streets is 15 ft. or greater. In such cases the radius is made 5 ft. greater than this distance.

Muskogee, Oklahoma. Here is a case where the narrower streets are given the greater radii; 24 to 30 ft. streets have radii at corners of 12 ft. to 15 ft., while for 30 ft. or over, a 10-ft. radius.

Pawtucket, Rhode Island, increasing radius from 15 to 25 ft. Davenport, 10 to 15 ft. Cheyenne, Wyoming, new pavements, 18 ft. Other cities report adopting radii of from 10 to 25 ft.

No information was received as regards the introduction of compound curves at corners.

Elimination of Catch Basins

The Committee received many replies concerning catch basin and inlet construction, and finds that there is a decided tendency toward eliminating catch basins, and connecting the inlets direct to sewers or storm water conduits, and especially is this done where there are adequate-sized storm sewers with good slopes.

The following cities report elimination, either complete or in progress: Quincy, Ill.; Muskogee, Okla.; Peoria, Kalamazoo, South Bend, St. Louis, Tulsa, Oklahoma City, Rockford, Shreveport, Long Beach, Houston, Cheyenne, Portland, Ore.; Oakland, Colorado Springs, Berkeley, Sacramento, Boise City and Salt Lake City.

An unusual method of disposing of storm water drainage is reported from Phoenix, Ariz. No storm water sewers have been constructed and, to care for storm water disposal, wells 6 ft. internal diameter are sunk to water-bearing sand, usually 20 and sometimes 30 ft. below the surface. Brick is used for construction, and within 6 ft. from the top it is of open construction and the bottom is left open. With proper inlets into the wells, it is asserted that satisfactory results are attained, the water-bearing sand taking away the discharge. The wells are expected to care for about 45,000 sq. ft. The diameter of inlet pipes to sewers are reported to range from 8 to 15 ins.

Storm Water Inlets

Information was sought as to size and type of inlets generally in use, and replies received would indicate that some standardization of construction would be desirable. Grade of streets and character of surface affecting run off, and amount of detritus carried, density of rainfall and minor local conditions all bear upon the best method to follow for carrying away surface water.

One answer received, while humorous, yet speaks the truth. The engineer reports that he can not see much advantage in the use of grates in the curb openings. Years ago the openings in the gutters in this country were held down to small square openings, limited to the size of a calf's hoof. Of late years calves are moved by truck, and some of these old grates will have to go.

Many cities report openings through curb only, others openings in gutters and in curbs. Many use rods, horizontal or vertical, or gratings in the curb openings. Others adopt clear openings from 6 to 8 in. in depth and of varying length. Openings into inlets are sometimes sunk an inch or so below curb grade and pavement sloped back to grade.

St. Louis standard inlets are 4½ ft. width in front and taper to 3 ft. 9 ins. back, with depth of opening 6 ins. and multiples of these are usual to meet variable conditions.

Approaches to Garage Driveways and Parking Places

Present practice seems to be generally to adopt a uniform slope from gutter or from curb sunk to within about 2 in. of gutter grade, up to sidewalk through grass plot, if such exists; if not, a short ramp with steep slope of from 1 to 2 in. to the foot.

Two or three cities, Rockford, Muskogee, Jacksonville, Hartford, merge curb and gutter with rather long radius from the face and short radius for top of curb, and vehicles pass over the curb without serious trouble.

Chicago installs some catch basins adjoining raised crossings to care for drainage flow, and construct aporns running back from top of curb, with grade of ½ in. to the foot.

Richmond, Ind.; Pontiac, Mich., Oklahoma City; Boise, Idaho and Indianapolis report constructing a gutter a few feet out from the curb, and constructing crossing ramp from this gutter to curb.

Special Curb and Gutter Construction

An innovation as to the cross section of curb is being introduced, which appears practical and beneficial. We all know that automobile and truck tires are often injured by grinding against the vertical rough stone curb, and a few cities are adopting a curb with a batter on the gutter side, and again this batter is sometimes merged with the gutter and curb formed with a curved face.

Jacksonville, Fla.; Shreveport, La.; Salt Lake City; Phoenix, Ariz.; Sacramento and Hartford are introducing this method to a greater or less extent.

Quite a number of cities, where they have bituminous type of pavements, are introducing a gutter of from 4½ to 6 ft. wide, built of concrete brick or hard surface, which would not be affected by gasoline or oil drippings from automobiles or trucks. Boise, Idaho; Muskogee, Sacramento and St. Louis report this improvement.

Sidewalk Design

Some additional information was obtained as regards sidewalk widths generally adopted ,and means of relieving congested foot traffic.

San Francisco is constructing underpasses for pedestrian traffic at major boulevard intersections.

A few replies received report fixed widths of sidewalks for varying street widths.

Oakland, California, reports for

40 ft. street, 8 ft. sidewalk
50 ft. street, 10 ft. sidewalk
60 ft. street, 14 ft. sidewalk
80 ft. street, 18 ft. sidewalk
100 ft. street, 20 ft. sidewalk

San Francisco:

40-50 ft. street, 10 ft. sidewalk
50-60 ft. street, 13 ft. sidewalk
60-70 ft. street, 15 ft. sidewalk
70-80 ft. street, 18 ft. sidewalk
80-100 ft. street, 19 ft. sidewalk
100-or over st., 22 ft. sidewalk

Streets less than 40 ft., sidewalk width one-fifth of street width.

Brookline, Massachusetts, allots one-sixth of the width of the street in business sections, where widths do not exceed 60 ft., to sidewalk space.

From twenty answers to our inquiry as regards width of sidewalk, we note the average width for residential streets to be from 4½ to 6 ft., and for business thoroughfares a varying width from 14 to 25 ft. Shreveport reports that 40 per cent of street width has to be allotted to sidewalk.

Special Features of Design

Oak Park, Ill., reports removal of grass plots in the center of certain thoroughfares, for parking places.

St. Louis has adopted additional parking space by surrounding certain areas in wide streets with curbing 2 in. high, over which autos to park can readily pass.

Brookline, Mass., has taken away a portion of the space formerly allotted for a bridle path, and uses it for parking space.

Boise City allots a width of 16 ft. for parking, in the center of a 100-ft. boulevard. Salt Lake City uses a strip bordering the street railway tracks for parking cars. Rockford, Ill., is designing streets with parkway in center.

In some cities there are commons or small parks, with sidewalks outside of them. These sidewalks could be transferred inside the commons and space used for parking. But to do this, state legislation is usually required. It would appear that individual treatment has to be given for each case, and every effort must be made to relieve existing conditions in many cities for care of cars.

Pavement Construction

In the past year two features are outstanding, which will result in economy as regards street construction.

The Department of Commerce has recently announced that the new standard for asphalt grading (as determined by penetration limits) becomes effective Jan. 1, 1924. Hereafter, instead of 50 or 100 grades, the new standard will comprise 10. This follows earnest work done by the producers and consumers, and it now behooves asphalt users to see that their specifications adhere to the adopted grades, the ranges for which, as regards penetration limits, is sufficient to provide for all reasonable requirements.

New standards for establishing sizes of brick were also consummated the past year, and instead of 66 varieties in use before standardization took place, there are now but 6.

The penetration limits for asphalt used in asphaltic pavements is being decidedly reduced, according to information received from a large number of cities. Also quite a few reports using additional amount of dust. The changes bring about a harder mixture and one that prevents pushing and shoving under traffic.

St. Louis, Chicago, Wichita, Oak Park, report the penetration used from 30 to 40 for heavy traffic streets; from 40 to 50 for lighter traffic; and a number report using a lower penetration without stating limits.

St. Louis, in addition to lowering the penetration limit, has increased the amount of material retained on a No. 40 sieve. The mix used in refined asphalt wearing surface being:

Retained on No. 10 mesh sieve	8%
Retained on No. 40 mesh sieve	34%
Retained on No. 80 mesh sieve	25%
Retained on No. 200 mesh sieve	10%
Passing 200 mesh sieve	14%
Bitumen	9%

Experience with this mix is reported to give a close compact surface, which irons out well and does not push or become wavy under traffic.

Information received from many engineers show that they are increasing the concrete base thickness and, in some instances, increasing the thickness of the wearing surface.

Peoria, Wichita, Davenport, Oak Park, St. Louis, Tulsa, Sioux City, Pontiac, Oklahoma City and New Orleans, report increase of depth of base of about 1 in. The average adopted for heavy traffic being from 7 to 9 ins., medium, 6 to 7 ins.; light, 5 to 6 ins.

It would be interesting to learn from what basis or theory the increase in thickness has been worked out, but our questionnaire unfortunately did not call for this information and none was furnished.

Indianapolis reports that the concrete base laid in the city shall be roughened by an approved roughening device.

Muskogee, Oklahoma, requires a compression test of concrete pavements, within a given period. Samples are taken from the pavement and, if the required test is not met, removal of the rejected section is required. If it runs 80 per cent of the strength required, it may remain in place and be accepted, the city reserving, however 20 to 50 per cent of the contract price for the yardage in question until the end of the payment period. In addition, the city is protected by the maintenance bond.

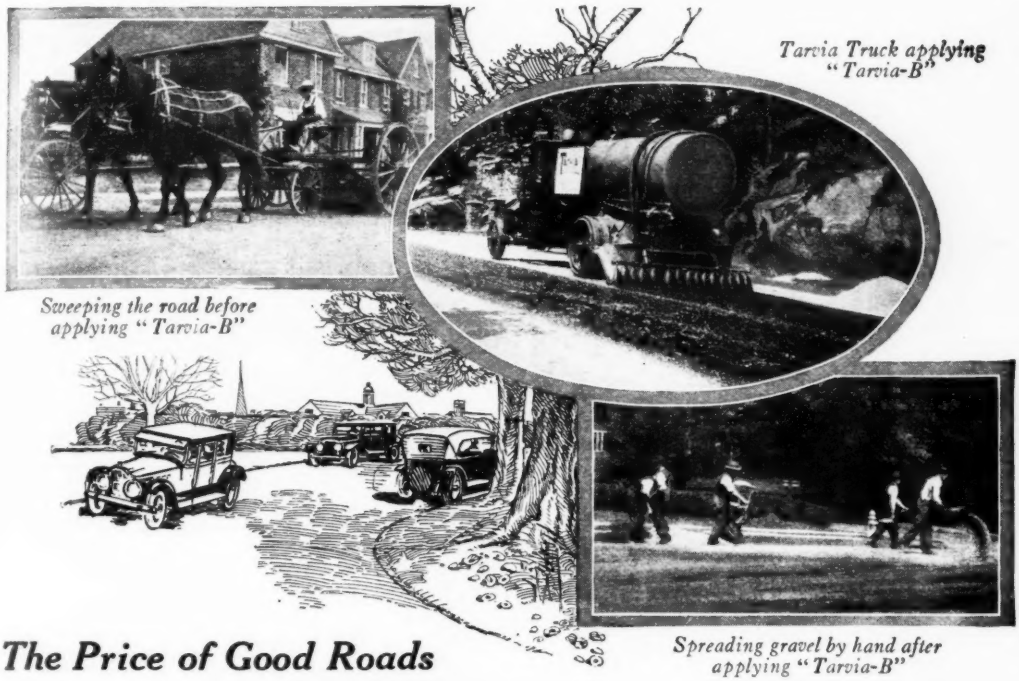
Mr. Carpentar of Pawtucket reports a rather unusual method of making payment, under the cost-plus basis. The paving done amounts to about $300,000 per year and is contracted for and paid on the cost-plus basis. Before the contract is made, a fair estimate of the cost per square yard is agreed upon and the contractor is to be paid the actual cost, plus 15 per cent upon the estimated cost, if the final cost does not exceed this sum. If the final cost does exceed this sum, he is to pay all such excess cost, until his percentage of profit is reduced to 10 per cent, as figured upon the estimated cost per square yard.

Beyond this point of reduction, the city will pay the extra cost. Should the contractor succeed in laying this pavement for less than the estimated cost, he will receive 15 per cent upon such estimated cost and one-half of the saving he will have made to the city.

CHICAGO BRICK SEWERS

Despite the fact that some of the old parts of Chicago have grown to be noted as the most thickly settled spots in this country, the same reliable never-failing brick sewers, laid over 60 years ago, have always been equal to the task.

The smaller sewers of Chicago are smaller sewers of Chicago are, of course, built of vitrified salt glazed clay pipe, as in any other city. Those of larger diameter are of hard-burned brick. They are plain circular sections, one brick thick up to a diameter of 2½ ft., two brick thick up to 10 ft. and four brick thick over 10 ft.



Tarvia Truck applying "Tarvia-B"

Sweeping the road before applying "Tarvia-B"

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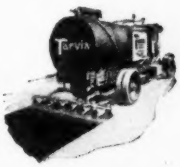

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—Air Compressors
—Asphalt Plant, Portable
—Asphalt Plant, Railroad
—Asphalt Tools
—Asphalt Tool Wagon
—Bar Cutters and Benders
—Bars, Reinforcing
—Bins, Portable Stone
—Bodies, Dump Truck
—Brick Rattlers
—Catch Basin Covers
—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
—Cranes, Locomotive
—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
—Industrial Cars
—Industrial Track
—Manhole Covers
—Mixers, Building
—Mixers, Hot
—Mixers, Paving
—Motor Trucks (1-3 tons)
—Motor Trucks (over 3 tons)
—Oil Distributors
—Portable Conveyor
—Portable Drilling Rigs
—Pile Drivers
—Pumps
—Reinforcing Steel
—Road Drags
—Road Forms
—Road Graders
—Road Mesh
—Road Planes
—Road Plows
—Road Rollers
—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
—Scrapers, Power
—Sheet Piling, Steel
—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
—Stone Screens
—Stone Spreaders
—Surface Heaters
—Tampers, Road
—Tractors
—Trailers
—Turntables
—Unloaders, Car
—Wagon Loader
—Wheeled Scrapers
—Wire Mesh

Contracts Awarded

ROADS AND STREETS

Ala., **Montgomery**—Newell Constr. Co., Ave. A, Birmingham, contract by State Hwy. Dept for 20 miles graveling and small amt. of grading, at $196,923.

Ala., **Selma**—Alabama Concrete Products Co., Selma Ala., awarded contract for grading and paving 180,000 sq. yds., First and Waters Aves., at $285,000.

Ark., **Mena**—J. J. Harrison, Okla. City, Okla., awarded contract to build 11.2 miles Foran Gap, Forest Hwy. Ark National Forest, Polk and Scott Cos., at $75,000.

Ark., **Russellville**—Western Construction Co., Little Rock, Ark., awarded contract at approx. $125,000 for bldg. 15 miles road with rock base with asph. and gravel binder from Dover no. to the Ozark Forest Reserve.

Cal., **Bakersfield**—Griffith Co., 502 L. A. Ry. Bldg., Los Angeles, awarded contract by Co. Supvrs. for impvt. of certain roads in Rd. Impvt. Dist. 26—Patch to Arvin—9.129 miles, at $238,000.

Cal., **Fresno**—W. F. Hanrahan, Brix Bldg., Fresno, awarded contract by City Comn. at $59,800 for paving McKinley Ave., involving 182,530 sq. ft. grading at 5.8c sq. ft.; 144,798 sq. ft. asph. pavement; 12,958 sq. ft. gutter; 6,898 ft. curb; 15,132 sq. ft. walk; 405 ft. 12-in. type A culvert; 93 ft. 12-in. B culvt. 66 ft. 18-in. culvt.; 12 manholes; E. A. McAlpin, Fresno, awarded contr. for impvt. of Wishon, College, Van Ness Blvd. and Horoa Sts., Fresno, at $4,874.

Cal., **Lynwood**—Hall-Johnson Co., Box 51, Inglewood, awarded contract for 404,100 sq. ft. paving on Poplar Dr., macadam, at $107,-500; 227,075 sq. ft. S. Long Beach Blvd., 5-6 in. conc., at $64,000; 109,000 ft. Long Beach Blvd., 5-6 in. conc., at $30,900.

Cal., **Redondo**—Kuhn Bros. awarded contract at 65c per square yard for impvt. of Topaz, Knob Hill, Elvira Aves., etc., by repaving approx. 258,485 sq. yds. with rock, oil and screening pavement.

Que., **Montreal**—B. Brault, Ltd., 2855 Rosemount Blvd., awarded contract for paving Gouin Blvd., 38,535 sq. yds., 3-in. asphalt, at $243,486.

Fla., **W. Palm Beach**—Palm Beach County Commrs. let contract for 7 roads as follows: 3 mi. Stuart-Annie rd. thru Hanson, Grant and 5 mi. St. Lucie Ave. rd., Salerno to Stuart-Annie rd. to McVey Lindsay, at $30,-166; R. Tomasello, contracts for following: 2 mi. Tropical Farms rd., at $15,600; 4 mi. Kerns rd. at $4,900; 3 mi. Napp rd. at $8,000; M. F. Myers at $32,500 for 61,000 ft. Stuart-Annie rd., ferry to Lake Okeechobee; Mulford rd., steel drawbridge across so. fork of St. Lucie river, to Champion Bridge Co., Atlanta, Ga., at $38,000.

Kans., **Anthony**—Shultz & Shultz, Wichita, awarded contract for grading and sand-clay surfacing 9.521 mi. Proj. 155, Sec. A, and 9.987 mi. FAP 154, Sec. A, Harper Co., both 18 ft., at $93,715 and $69,139 respectively.

Ky., **Frankfort**—Following contracts let by State Hwy. Department: Daviess Co., 2.64 mi., grade and drain, to Costello Bros., Knoxville, Tenn., at $25,051; Henderson Co.,

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30 North LaSalle St. CHICAGO, ILL.

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—Air Compressors
—Air Lift Pumps
—Ash Handling Mach'y
—Backfillers
—Brass Goods
—Chimneys
—Chloride of Lime
—Chlorinators
—Coal Handling Machinery
—Concrete Hoisting Equipment
—Concrete Tanks
—Condensers
—Conduit Rods
—Cranes, Locomotive
—Cranes, Traveling
—Curb Boxes
—Curb Cocks
—Derricks, Pipe Laying
—Derricks, Steel Portable
—Drinking Fountains
—Dry Feed Chemical Apparatus
—Engines, High Duty
—Engines, Gas
—Engines, Oil
—Engines, Pumping
—Explosives
—Fence, Iron
—Fittings, Wrought
—Filter Equipment
—Gates, Sluice
—Gauges, Recording
—Gauges, Steam
—Gauges, Water
—Goose Necks
—Hydrants, Fire
—Indicator Posts
—Lead
—Leadite
—Lead Furnaces
—Lead Wool
—Leak Indicators
—Liquid Chlorine
—Lime
—Meter Boxes
—Meter Couplings
—Meter Testers
—Motor Trucks
—Motors, Electric
—Oil, Lubricating
—Pipe, Cast Iron
—Pipe Cutters
—Pipe, Lead-Lined
—Pipe, Steel
—Pipe, Wrought Iron
—Pipe, Wooden
—Pitometers
—Pumps, Air Lift
—Pumps, Boiler Feed
—Pumps, Centrifugal
—Pumps, Deep Well
—Pumps, Steam
—Pumps, Trench
—Pumps, Turbine
—Pumping Engines
—Service Boxes
—Soda Ash
—Specials, Cast Iron
—Standpipes
—Steam Boilers
—Steel, Reinforcing
—Sulphate of Alumina
—Tamping Machines
—Tanks, Elevated
—Tapping Machines
—Trench Braces
—Trenching Machines
—Valve Boxes
—Valve Inserters
—Valves, Gates
—Valves, Pressure Regulating
—Water Main Cleaners
—Water Meters
—Water Softening Plants
—Welding Apparatus
—Well Drills
—Well Screens
—Well Strainers

8.599 mi. gravel, to Corum Bros., Madisonville, Ky., at $155,948; Hopkins Co., Sec. G, 8.82 mi. gravel to Peacock Const. Co., Yaio, Mich., at $95,003; Hopkins Co., Sec. F, 10.368 mi. gravel to N. E. Stone & Co., Madisonville, Ky., at $136,604; Knox Co., 2.485 mi. grade and drain to Costello Bros. & Lusk, Knoxville, Tenn., at $65,857; McLean Co., 5 595 mi. gravel to Corum Bros., Madisonville, Ky., at $60,49; Nicholas Co., 7 mi. waterbound macadam to J. S. Walton & Co., Princeton, Ky., at $39,445; Webster Co., 19.16 mi. gravel to Peacock Const. Co., Yale, Mich., at $209,802; Campbell Co., 3.156 mi. conc. to Edw. Hine & Sons, Harrison, O., at $111,534; Campbell and Pendleton Cos., 10.112 mi. concrete to Cynthiana Const. Co., Cynthiana, Ky., at $393,648, also constr. of 6.319 mi. conc. in Kenton Co., at $197,576; Powell Co., 1.306 mi. grade and drain to Robt. L. Shimfessel, Clay City, Ky., at $4,216; Pulaski Co., 0.137 mi. waterbound macadam to Cash & Lynn, Stanford, Ky., at $8,180.

Ky., Jackson—Northfork Construction Co., Jackson, awarded contract by State Hwy. Dept., for 7.32 miles Jackson-Compton rd. from Wildhurst to Wolfe Co. line, at $204,818.

Ill., Springfield—Following contracts let by State Hwy. Dept.: Paving Sections—S. B. I. Rte. 2, F. A. P., Sec. 78, Winnebago Co., 3.66 miles, 18 ft. in width, to Geo. W. Welch, Beloit, Wis., at $69,428; Sec. 7, Proj. 55, Bureau Co., 3.17 mi., 18 ft. wide, to M. Hayes & Sons, Chicago, Ill., at $74,782; Sec. 17, I, Proj. 55, Bureau Co., 3.65 mi., 18 ft. wide, to same contractor at $89,886. Grading Sections—Louis Rich Constr. Co., E. St. Louis,, Ill., contracts as follows: Rte. 34, Secs. 1A, 2A, 3A, 4A and 5A, Saline, Pope-Hardin and Hardin Cos., 4.57, 5.78, 5.32, 5.60 and 6.54 miles, at $44,457, $33,458, $69,632, $45,750 and $127,878 respectively.

Ill., Winnetka—H. G. Goelitz, 810 North Blvd., Oak Park, Ill., awarded contract by Bd. of Local Impvts., for 12,000 sq. yds. rein. conc. pavement, at $119,000.

La., Crowley—McIntosh Co., Okla. City, awarded contract for installing fire alarm system and paving with rein. conc. or sheet asphalt Parkenson Avenue, at $196,845.

Md., Baltimore—Board of Awards let contracts for grading, curbing and paving streets in Contr. 245-OCOANA; 3,290 sq. yds. vit. brick, 14,760 c. y. grading, to D. Marine, Knickerbocker Bldg., $62,440; streets in Contr. 264-OANA, 22,170 sq. yds. asphalt, to Baltimore Asphalt Block and Tile Co., 1320 N. Monroe St., at $96,248.

Mass., Boston—State Hwy. Dept. let contracts for bitum. mac. paving on 21,046 ft. highway, 18 ft., in Truro and Wellfleet, to Lano Constr. Co., 37 Colony St., Meriden, Conn., at $110,086; 2,480 ft., 30 ft. wide in Scituate, to Reynolds Bros., Inc., 179 Summer St., Boston, at $28,068.

Mich., Lansing—State Trunk Line contracts let as follows: Rd. 25-2 A, Luce Co., Pentland Twp., Cl. B, 16 ft. wide, 5.977 mi., to Luce County Rd. Comn., Leland, Mich., at $82,991; Rd. 40-6, B, Van Buren Co., Paw Paw and Almena Twps., Cl. B, 16 ft. wide, 5.421 mi., to Wilder, Gould & Cross, Grand Rapids, Mich., at $60,579. Rd. 27-17, A-1, A-2, A-3, St. Clair Co., Clay and Cottrellville Twps., Cl. D. S., 1,874 mi., to Closser Bros., Detroit, at $3,873. Rd. 27-17-A-A, St. Clair Co., Cottrellville Twp., grading and shaping, 0 692 mi., to Closser Bros., Detroit, at $1,536. Rd. 27-17, A-1, St. Clair Co., Clay and Cottrellville Twps., grading and sheet piling, 0.311 miles, to Closser Bros., Detroit, at $4,959. Rd. 16-1, A-1 and C-1, Livingston Co., Green Oak and Brighton Twps., Cl. G and DS, 0.644, 0.227 miles, to State Construction Work, at $8,800. Rd. 16-23, Livingston Co., Geno and Brighton Twps., Cl. G and DS, 0.491 mi., to State Construction Work, at $4,950. Fed. Aid contracts let as follows: Rd. F. A. 89-D, Jackson Co., Parma Twp., Cl. F, 20 ft. wide. 5 696 mi., to Rockford Const. Co., Rockford, Ohio, at $124,395; Rd. F. A. 89-D, $49,290 est. cost of cement.

Mich., Lansing—Following Mich. Trunk Line contracts let: Rd. 14-10 A, Clare Co., Hayes Twp., Cl. B, 16 ft. wide, 1.669 mi., to Bruce, Stockwell & McAnnish, Harrison, Mich., at $13,959; Rd. 27-6 A and B, Huron Co., Sand Beach and Sherman Twps., Cl. B, 16 ft. wide, 9.329 mi., to Huron Co. Rd. Comn., Bad Axe, Mich., at $98,464; Rd. 13-32 B, Emmet Co., Harbor Springs, Cl. F. Base, 20 ft. wide, 0.563 mi., to W. B. Chalmers Co., Grand Rapids, Mich., at $9,186; Rd. 4606, Ingham Co., Stockbridge, culvt., to J. W. McKnight, Big Rapids, Mich., at $2,985; Rd. 13-32 B (est. cost of cement), $3,075; Rd. 55-10, Roscommon Co., Roscommon Twp., Cl. B, 16 ft. wide, 6.304 mi., to Du Vall Bros., McBain, Mich., at $58,771; Rd. 51-6, Ottawa Co., Holland Twp., Cl. F-rein., 20 ft. wide, 1.110 mi., to Ottawa Co. Rd. Comn., Grand Haven, Mich., at $28,527; Rd. 51-6 (est. cost of cement), $9,532.

Mich., Lansing—State Trunk Line contracts let as follows: Rd. 17-6, A-2 and B, Washtenaw Co., cities of Ann Arbor and Ypsilanti, Cl. sheet asphalt, 20 ft. wide, 1.108 mi., to Ann Arbor Asphalt Constr. Co., Ann Arbor, Mich., at $29,762; Rd. 49-12, Ingham Co., Vevay Twp., Cl. Culvert, to Ingham Co. Rd. Comn., Mason, Mich., at $1,904. Mich. Fed. Aid contract awarded to E. A. Campbell, Kalamazoo, at $144,780 for Rd. 66C, St. Jos. Co., White Pigeon and Sturgis Twps., Cl. F-Rein., 18 feet wide, 6.380 miles.

Minn., St. Paul—Contracts for paving, grading, graveling, brdgs., culverts, etc., let by State Hwy. Dept. as follows: State Proj. 5-34, FAP 92. 23.6 mi. Paving to Universal Engrg. Co., Eau Claire, Wis., at $307,871; graveling to Central Rd. Constr. Co., Minneapolis, at $25,770; State Proj. 3-34, FAP 303, 14.6 miles; grading to Winstone Bros., 801 Globe Bldg., Mnpls., and Geo. J. Grant Constr. Co., St. Paul, at $179,383; culverts to David Graham, Hibbing, at $24,852; State Proj. 1-39, Div. B, FAP 296, 7 mi.; grading to Cameron & Joyce, Keokuk, Ia., at $46,662; culverts to Guaranty Constr. Co., 301 Essex Bldg., Mnpls., at $4,623; brdg. 4007 to Campbell Constr. Co., 3050 Hennepin Ave., Mnpls., at $13,800. State Proj. 16-21, FAP 314, 17.2 mi.; grading (A) to Spencer & Chambers, Marshall, at $61,886; grading (B) to Stevens Bros., St. Paul. at $68,004; culverts to Noble Peterson, Windom, at $7,148; bridge 3796 to Independent Bridge Co., 1101 Met. Life Bldg., Mnpls., at $11,000; brdg. 3795 to Guaranty Construction Co., 301 Essex Bldg., Mnpls., at $16,460; bridge 3797 to Iowa Bridge Co., 317 McKnight Bldg., Mnpls., at $11,888. State Proj. 16-22, FAP 315, 7 mi.; grading to Lobnitz Grading Co., Olivia, at $24,990; culvert to Chas. N. Hanson, Atwater, at $4,711. State Proj. 32-24, FAP 323, 7 miles; grading to be awarded later; culverts to the Pritchard Co., Thf. River Falls, at $1,486.

Miss., New Albany—Nixon & Phillips, Lineville, Ala., awarded contract by Union Co. Supvrs. Dists. Nos. 1, 2 and 3, at $155,-132, 20-mile road.

Nev., Carson City—C. Miles, Sacramento, awarded contract by State Dept. of Hwys. for grading and constructing culverts in Washoe Co. on Proj. 73, at $74,693; Fred Coolidge, Laramie, Wyo., contract by State Dept. for constr. of Proj. 56, grading, constructing culverts and placing gravel surf. in Churchill Co., bet. Eastgate and East County line, at $173,147.

N. J., Asbury Park—J. J. Barrett, No. Olden Ave., Trenton, awarded contract for bitum- conc. paving of 27,000 sq. yds. Kingsley St. and 17,500 sq. yds. Coolman Ave., at $102,339.

N. Y., Brooklyn—Following contracts let by E. Riegelmann, Boro. President: Sicilian Asphalt Pav. Co., 41 Park Row, New York, contract for repaving N. 7th St., at $33,793, Saratoga Ave., $13,714, both asph.; Uvalde Asphalt Paving Co., 1 Bway, New York, 12th Ave., $22,364; Douglass St., $7,462; Suydam St., $5,997; regrading and paving Kingston Ave., $18,696, all asphalt; Cranford Co., 52 Ninth St., repaving 79th St., $20,020; 80th St., $8,407; paving 46th St., $5,681; 77th St.,

$18,977; 77th St., $9,602; 83rd St., $8,971, all asphalt; Brooklyn Alcatraz Asphalt Co., 407 Hamilton Ave., repaving 99th St., $7,333; paving E. 14th St., $8,161; E. 19th St., $10,-916; W. 27th St., $9,882, all asphalt; Greico Bros., 12 Russell St., repaving N. 7th St., St., granite blk., at $32,897; J. D. Norton, 20 Sterling Pl., Union St., granite blk., $70,885; W. J. McHale Contg. Co., 1250 Jefferson St., grading, curbing and flagging 40th St., $5,-520; F. Persioano, 350 Fulton St., 80th and 81st Sts., $902; G. M. Mandatto, 129 29th St., E. 19th St., $3,435.

N. Y., Brooklyn—N. J. O'Hara, 1228 Park Ave., New York, awarded contract by Park Board, Municipal Bldg., for grading, sheet asph. paving, etc., main roadway of Eastern Parkway, from Albany to Ralph Aves., here, at $147,081.

N. Y., Long Isl. City—Sicilian Asphalt Paving Co., 41 Park Row, New York City, awarded contract for grading, curbing, laying sidewalk, etc., on 101st (Jerome) Ave., at $110,020.

N. Y., New York—Fleming Shepard, Inc., 116 Broad St., awarded contract by Pres. Manhattan Boro. for grading, regrading, curbing, flagging and reflagging W. 165th St., at $11,046; repaving Riverside Dr., stone-filled sheet asph., to Asphalt Construction Co., 208 Broadway, at $137,657.

N. C., Salisbury—Ely Constr. Co., Augusta, Ga., awarded contract for sheet asphalt paving—40,000 sq. yds. various streets —at $166,000.

Oklahoma, Guymon—Jas. Stanton Constr. Co., Leavenworth, Kans., award. contract at $70,000 to pave 5 blocks on Main St., and at $20,000 for impvts. around Rock Island R. R. station.

Okla., Okla. City—State Hwy. Dept. let contracts as follows for 3 roads: Creek Co., Proj. 88, 1.63 mi. hard surface road, to General Construction Co., Okla. City, at $54,168; Pawnee Co., Proj. 85, 11.57 mi. gravel rd., to McCoy & Son, at $144,973; Ottawa Co., 3.64 mi. reconstructed old rock base rd., with chats and Topeka top, to General Construction Co., Okla. City, at $85,315.

Okla., Okla. City—City let contracts at $82,376 for paving about 10 blocks as follows: Western Paving Co., at $24,979, for Ave. B; at $19,946 for 45th St.; $9,998.35 for 44th St.; Reinhart & Donovan, to pave alley in Blk. 39, and at $10,452 for Ave. B, Klein to Douglas; M. A. Swatek Co., for 11th St., to Blks. 15 and 16, Summers Addn., and at $9,119 for 11th St.; all Okla. City.

R. I., Providence—State Bd. Pub. Works let contracts as follows: Bitum. macadam pavement 3.04 miles Pontiac Rd., 18 ft., in Cranston and Warwick, to Lane Constr. Corp., 37 Colony St., Meriden, Conn., at $89,024; 3.09 mi. Cumberland-Wrentham Rd., 18 ft., in Woonsocket, to B. Perini & Sons, Ashland, Mass., at $102,053.

Tex., Angleton—P. G. Burns, Angleton, Texas, awarded contract Brazoria Co. Rd. Dist. No. 16, at $350,000, for 1st section of crushed rock, shell and asphalt road north from Anchor, at $350,000.

Tex., Center—Bramer & Wilder, Houston, Tex., awarded contract by City and Shelby Co. for paving as follows: City, $40,131.62; County, $122,847.

Tex., Coleman—Buchanan & Veasey, Temple, awarded contract for gravel surfacing rd. bet. Rockwood and Colorado River; grade and construct draing. structs, on Coleman-Glen Cove rd. to E. Blankenstein, Temple, Tex.; 8 steel trusses with conc. flrs. and conc. substruct. to Austin Bridge Co., Dallas; total, $80,000.

Tex., Dallas—Fuller Constr. Co., Slaughter Bldg., awarded contract for paving with Willite asph. conc. 2-in. top on 6-in. conc., 137,058 sq. yds. on various streets, at $455,697.

Tex., Hemphill—Sabine County let following contracts for roads: Concrete drainage structs. and laying iron ore gravel on 7.10 mi. State Hwy. 21, Milam to Pendleton, to E. M. Wood, Royse City, Tex., at $120,006; construct conc. culverts and timber brdg. and lay 8-in. gravel on 8.38 mi. State Hwy. No. 8, Brookeland to Pineland, to George & Kerr, Lufkin, Texas, at $131,000.

Tex., Kountze—Brimmer & Wilder, Houston, awarded contract by Hardin County for 2 roads; grade, construct bridges, culverts and gravel 14 miles State Hwy. No. 40, Kountze to Village Hills, at $60,000; grade and improve 12 miles State Hwy. No. 8, Silsbee to Evadale, at $115,000.

Wash., Olympia—Following contracts let by State Hwy. Comn.: 1—Clearg., gradg. and draing. abt. 4.09 mi. Anatono-Asotin hwy. from Asotin south in Asotin Co., at $48,149; 2—Clearg., gradg., draing. and surfacg. with gravel about 2.93 miles perm. hwy. No. 9, from Anacortes east in Skagit Co., at $29,-514; 3—Clearg., gradg., draing. and surfacing with crushed gravel abt. 5.81 miles of N. Central hwy. betw. Jared and Blueside, in Pend Oreille Co., at $83,375; 4—Gradg., draing. and surfacing with crushed rock about 12.2 miles of N. Central hwy. from Odessa west in Lincoln Co., FAP 129, at $99,294; 5—Grading, draining and surfacing wjth crush. gravel abt. 11.7 mi. Inland Empire Hwy., bet. Wallula and Burbank, Walla Walla Co., at $5,157.

Wash., Seattle—Romano & Co. awarded contract for sewers in 32nd Ave. south et al. (clay pipe) at $39,139; Goetz & Brennan, contract for grading, paving, etc., Avalon Way et al., at $320,508 (clay pipe), also awarded contract for sewers in Brandon St. et al., at $81,588 (clay pipe); C. L. Creelan, contract for paving 59th Ave. S. W., at $6,200; also contract for paving, filling, etc., W. Connecticut St., at $8,374.

SEWERAGE AND SEWAGE TREATMENT

Ark., Hot Springs—Ed B. Mooney, local, awarded contract for laying 10,400 ft. sewer at $41,000.

Cal., Alhambra—Hickey & Harmon, 58 2nd St., San Francisco, awarded contract for constr. of sewer system in Dists. 3 and 5, at $62,386 for Dist. 3 and $74,384 for Dist. 5. Work involves 52,956 lin. ft. 8-in. vit. sewer, 137 manholes, 46 flush tanks, 1,491 hse. connections of 4-in. cast iron pipe.

Ont., Ft. Erie—F. F. Fry Co., Ltd., 43 Scott St., Toronto, awarded contract for conc. and vit. clay sewers at $43,270.

Cal., Long Beach—P. S. Tomich, 425 N. Fremont, Los Angeles, awarded contract for constr. of sewer system in Anaheim, Daisy, Loma Vista and other streets at $78,000.

Cal., Pasadena—S. M. Milovich, 858 S. Figueroa St., Los Angeles, awarded contract for constr. of sewer system on Allen Ave., Mountain St. to city limits, at $1,899; Adam Dalmatin and Mike Guho awarded contract for constr. of Linda Vista sewer sys., at $67,000; Dan Oakovitch awarded contract for sewer system in Palm Terrace and Claremont Dr., at $4,800.

Ont., Fort Erie—F. F. Fry, Ltd., 43 Scott St., Toronto, award. contract for sewerage system at $50,000.

Ont., Sandwich—Webster Constr. Co., Bank of Toronto Bldg., London, awarded contract for Partington Ave. sewer, at $30,-000.

Iowa, Des Moines—G. G. Herrick, 607 Observatory Bldg., awarded contract for Southwest Sewerage System; 43,806 lin. ft. 10-24 in. pipe sewer; 28,100 lin. ft. 27-48 in. circ. sewer; 1 dry weather outfall complete, 1 inverted siphon, etc., complete, at $626,909.

Kans., Cherryvale—Ammerman & Snyder, Wichita, awarded contract for sewage disp. plant and outfall sewer at $51,366.

Md., Baltimore—Ryan Constr. Co., Real Est. Bldg., Philadelphia, awarded contract for constr. of storm water drains and sanitary sewers in Bellwood Ave., near Belair Rd. Storm water constr. 64,900 ft. 6-9 ft. rein. conc. drain and 700 ft. 18-ft. in. san. sewer, etc., at $33,482.

Md., Baltimore—D. C. McAleer, Phoenix Bldg., awarded contract by Board of Awards for sewers in Storm Water Contr. 61 and in San. Contr. 206, at $49,928 and $59,724 respectively.

Mich., Springwells—T. D. Nolan, 22 Highland Ave., Highland Park (Detroit P. O.), contract for 7,290 ft. 12-27 in. vit. crock sewer in Special Assessment Dist. 23, at $14,900; S. Healy, 400 Penobscot Bldg., Detroit, 2,464 ft. 36-72 in. conc. sewer in Sec. 39, Ford Rd. sewer, $34,889; 2,470 ft. 36-66 in. conc. sewer in Sec. 40, Donald Ave., at $34,889.

Minn., Winona—Wm. Fraser & Son, 810 Guardian Life Bldg., St. Paul, awarded contract in conjunction with Pastoret Constr. Co., 308 Sellwood Bldg., Duluth, for laying sewers, at $93,301.

Mo., Marceline—Ray & Son, Baxter Springs, Kansas, awarded contract for main sewers and sewage disposal plant, at $50,247.

Mo., Ridgeway—Ole Johnson, Alden, Ia., awarded contract for construction of sewer system at $90,000.

Mo., St. Joseph—Hanson & Willadson, Omaha, Neb., awarded contract for construction of lower Whitehead sewer, at $114,675.

Mo., St. Joseph—Owings & Shofner, Atchison, Kans., awarded contr. for 3,136 ft. rein. conc. double box and 2,186 ft. 9x9 ft. conc. box sewer for Browns Branch, at $211,226.

Mo., Unionville—Gjellefald-Chapman Co., Forest City, Ia., awarded contract for san. sewers at $71,835.

N. Y., Long Isl. City—D. Nonnacci awarded contract for san. sewer in Owens St., etc., at $81,487.

N. Y., Syracuse—Roberts Filter Co., Darby, Pa., awarded contract for equipment and machinery for disposal plant, at $76,000.

O., Cleveland—Winterbottom & Connelly, 1815 Corning Ave., award. contract for segmental blk. sewers in Ridge Rd. (Secs. 1-7), at $193,056.

Ohio, Columbus—Following contracts let for sewers: Franklin Co., 12,608 ft. 8-18 in. vit. sewer and 3,000 ft. 8-in. cast iron mains in Sewer Dist. Marion 2 (No. Whittier Garden area), Contr. 16, to W. D. Winchell, 338 Seibert St., at $41,783; 3,556 ft. cast iron mains in Sewer Dist. Franklin 3, Contr. 29, and 2,644 ft. 8-in. vit. sewers in Sewer Dist. 3, Contr. 28, to W. Neilson, 160 Lane Ave., at $5,626 each.

Ohio, Euclid—Contracts for sewers and water mains in 4 streets to J. B. Lyon, Euclid, at $8,448; 3 streets to Massouff & Co., 3184 W. 25th St., Cleveland, at $5,527; 5 streets to A. C. Hattendorf, Stop 14, Euclid Ave., Cleveland, $48,992; 5 streets to Curro & Whitaker, 2269 Noble Rd., Cleveland, at $46,505.

Ohio, Euclid—F. B. Stein, Euclid, awarded contract for disp. plant for Lake Shore Blvd., at $190,616.

O., E. Liverpool—P. Milliron, 2nd St., awarded contract for 1¾ miles san. sewer in Sewer Dist. 2, East End, at $90,000.

O., Zanesville—Adams Bros. Cotg. Co., Muskingum Ave., awarded contract for lateral sewers for Southwest sewerage system, at $305,150.

Pa., Wilkes Barre—B. G. Coon Constr. Co., Wilkes Barre, awarded contract for brick storm sewers in Bowman, Skidder and Scott Sts., at $49,282.

Tex., Clarksville—Mitchell Constr. Co., Houston, awarded contract to construct sewage disposal plant and sewer lines. Cost about $30,000.

Tex., Laredo—Kirkwood & Wharton, San Antonio, Tex., awarded contract at approx. $63,000 for constr. of storm sewer. Pre-cast rein. concrete pipe will be used for the main sewers.

Tex., Stamford—McAman Constr. Co., Stamford, awarded contract for ½-m. g. plant and Imhoff tanks, at $31,500.

Va., Richmond City—Smith Bros. awarded contract for constr. of sewers on various streets at $81,433; for materials, Warner, Moore & Co., at $59,073.

Wash., Seattle—Romano & Co. awarded contract for sewers in 32nd Ave., et al., at $39,139 (clay pipe); also contract for sewers in Brandon St., et al., at $81,588 (clay pipe).

WATER SUPPLY AND PURIFICATION

Cal., Los Angeles—Pacific Pipe & Supply Co., 1002 Santa Fe Ave., awarded contract by Public Service Comn. for furnishing French made cast iron pipe f. o. b. Aqua siding, in 4-metre lengths, at $325,788.

Colo., Denver—R. L. Hanes, 617 E. 1st Ave., awarded contract for impvts. to Ashland Ave. reservoir, east and west basins, at $85,477. Extra wk.: Item 1, excav. and grading, $1.60 per c. y.; Item 2, removing condemned soil and replacing with new soil, $2.50 cu. yd.; Item 3, conc. and form work, $18 per c. y. Large c. i. pipe (altern. prop. accepted) to U. S. Cast Iron Pipe & Fdry. Co., Tarrant City, Birmingham, Ala., at $175,067; small pipe to Colorado Fuel & Iron Co., 6-24 in. pipe, $60, total $74,627; vert. valves to Rensselaer Valve Co., 50 Church St., N. Y. City, 25 4-in. hub end, 250 6-in., 30 8-in., 15 10-in., 75 12-in. two 24-in., 10 24-in., 15 36-in., 4 48-in., 3 48-in. flange; total, $69,895.

Idaho, Lewiston—Chanut Constr. Co., Chanute, Kans., awarded contract for water works impvts., including filtr. plant, 2 reservoirs, 6 miles cast iron pipe, etc., at $346,600.

Ind., South Bend—Board Public Works let contracts for water works station as follows: Bldg. and founds., to Hay-Wever Co., So. Bend, at $157,400; suct. well to Phelps & Son, Knoxville, at $27,000; chimney to H. R. Heinicke, Inc., 540 N. Meridian St., Indianapolis, at $6,083; pumps to Allis-Chalmers Co., 1410 Waldheim Bldg., Kansas City, Mo., at $69,900; boilers to Union Iron Wks., Lackawanna Siding, Hoboken, N. J., at $23,008; coal and ash handling equipt., to Link-Belt Co., 910 S. Mich. Ave., Chicago, at $12,143.

Ky., Pond Creek—J. E. Nelson & Sons, 3240 S. Michigan Ave., Chicago, awarded contract by Ill. Central R. R. Co., 135 E. 11th Pl., Chicago, for pumping station, elev. steel tank, etc., here. Cost to exceed $40,000.

Ky., Powderly—J. E. Nelson & Son, 3240 S. Michigan Ave., Chicago, awarded contract by Ill. Central R. R. Co., Chicago, for water treating plant and pumping station; est. cost, $40,000.

Kans., Kansas City—Arkansas Bridge Co., 1503 Waldheim Bldg., Kansas City, Mo., awarded contract for rein. conc. reservoir, 259x433 ft., 24 ft. high, at $274,600.

Kans., Winfield—Central Fdry Co., 332 S. Michigan St., Chicago, Ill., awarded contract for water works extensions, including 22,000 ft. 16-in. pipe, at $87,560.

Mass., Stoneham—(Boston P. O.) Worthington Pump and Mchy. Corp., 115 Broadway, New York City, awarded contract by Met. Dist. Comn. for crank and flywheel cross-compound pump, 20-m. g. d., at $69,000.

Miss., Moorhead—G. P. Sledge, Abbeville, La., awarded contract to construct water works plant at cost $50,000. Wk. includes 100,000 gal. tank lines, 8-in., 6-in. and 4-in. pipe; two 500-g. p. m. pumps, etc. Henry A. Mentz, Cons. Engrs., Magnolia, Miss.

Mo., Canton—James & Anderson, Woodriver, Ill., awarded contr. for water works and sewers at $74,000.

Mo., Ridgeway—C. C. Johnson, Iowa Falls, Iowa, awarded contract for water works, at $40,420.

N. Y., Albany—E. B. Stevenson, Albany, awarded contract for repairing retaining wall of basins, removing and replacing new sand, etc., in filtration plant, at $62,277.

N. Y., Long Isl. City—J. A. Gregory, 351 E. 124th St., New York City, awarded contract for water mains in Anable, Woolsey and 6th Aves., etc., at $42,572.

N. C., Andrews—Mayor let following contracts for constr. work on proposed municipally-owned hydro-electric power plant on Hiawassee River: Tucker & Laxton, Inc., Charlotte, N. C., awarded contract for construction of power house, dam, substation and transmission line from plant to Andrews; all electrical equipt. to General Electric Co., Schenectady, N. Y.; S. Morgan

Smith, York, Pa., contract for all hydraulic equipt. and accessories.

Okla., Sulphur—W. B. Scott, Sulphur, awarded contract for motor driven pump units, conc. reservoir, tower, 4,400 ft. 6 and 8-inch cast iron pipe, etc., at cost plus 10 per cent, not to exceed $43,500.

Okla., Tulsa—E. J. Merkle, Kansas City, Mo., awarded contract to construct Mohawk pumping station (Spavinaw water project), at $220,000; Jno. V. Bolan, St. Louis, Mo., at $5,000 for conc. chimney. Will probably let contract to H. L. Cannaday, Tulsa, for pipe line system.

O., Cleveland—Stange-Walsh Constr. Co., 2315 Fairmount Rd., contract for filter and administration bldgs., and 7 gatehouse superstructs. for Baldwin filtration plant, Contr. 47, at $2,885,300; Schrader Construction Co., Euclid-46th St. Market Bldg., award. contract for 1-sty. 30x40 ft. conc. gate houses at Fairmount reservoir, at $63,-313.

Ore., Beaverton—American Woodpipe Co., Tacoma, Wash., awarded contract for new city water system here, at $42,911. Six miles 8-in. main are to be laid from Council Crest, near Portland, to connect with reservoir to be built 1 mile east of city.

Wash, Yakima—Coluccio & Erickson, Yakima, awarded contract for conc. pipe line to be installed on 7th St., at $50,676.

Prospective Work

ROADS AND STREETS

Ala., Mobile—City contemplates expendt. of $302,960 for paving certain streets here. Wright Smith, City Engineer.

Ark., Arkadelphia—State Hwy. Dept., Little Rock, Arkansas, plans to improve Arkadelphia-Hot Springs rd.; also 5 miles Bankhead Hwy., from Arkadelphia to Caddo river brdg.

Ark., Little Rock—State Hwy. Dept., Little Rock, contemplates expending about $3,-300,000 for impvt. of highways in Pulaski County.

Cal., Nat'l Forest Rd.—Dist. Engr., Bureau of Public Roads, U. S. Dept. of Agriculture, No. 9 Main St., San Francisco, plans to advertise Yuba Pass National Forest Hwy. Proj. early in January, for constr. during season of 1924. Location survey made of project and center line staked. Blue prints showing center line and tentative grades ready for distribution to interested contractors. Design and contract quantities not yet completed. C. H. Sweetser, Engr.

Cal., Sacramento—Practically all of the Calif. sec. of Pacific Hwy. bet. Redding and Ore. state line, excepting those stretches now paved, will be rebuilt within next 2 yrs. Commission prepared to spend $1,500,000 or more in abolishing curves, widening rd. to width of from 24 to 30 ft., and cutting down grades on the 50-mi. rd. so. from Dunsmuir to Redding. There is a total of 140 mi. thru mountainous sects. of Shasta and Siskiyou Cos., of which 52 miles are paved.

Fla., Barton—Polk County plans to construct 106 mi. 15-ft. asphalt road and widen 9-ft. rd. to 15 ft. Will vote on $3,360,000 bonds. For detailed information address Co. Commrs.

Fla., Brooksville—Hernando County Commrs. plan to construct 70 miles of rock and asphalt roads. Contemplate voting on $450,-000 bonds.

Fla., Frostproof—City considering 9 miles of street paving, extending of water mains, erecting city hall, etc.; $300,000 bonds voted.

Ga., Atlanta—Peters St. Impvt. Assn. (Geo. W. West, Pres.) interested in widening Peters St., S. Forsyth to Park St., west end. City will furnish $140,000. C. E. Kauffman, Engr. in Dept. of Constr.

Ga., Thomasville—City plans to expend $100,000 for additional street paving.

Idaho, Boise—Contracts for $1,000,000 road work will be let by State Hwy. Comn. before January 1, 1924. Contract for paved hwy. in Shoshone Co., bet. Kellogg and Mullan, 17 miles, to cost abt .$700,000, will be let this year and work will start as soon as possible in 1924. Within a month contract for hwy. work bet. Priest river and Laclede, 7 miles, will be let, involving expenditure of $175,000. Wm. J. Hall, Commr.

Ill., Wyoming—Town is preparing to pave about 12 blocks in business section; work will start in spring. Jos. L. Duran, Supt. Stark County, Toulon, Ill.

Ia., Jefferson—Greene County will complete paving of Lincoln Hwy. across county in 1924; 1,800 carloads of material, 4,600 tons material per mile of work done; 87,400 tons for project. Est. cost, $28,000 per mile, or $518,000 for project; $453,250 Fed. aid; Co. to pay $64,750. G. A. Coburn, Co. Aud.

Iowa, Manchester—City contemplates paving 60 blocks during 1924. Engineer not selected. F. B. Blair, Mayor.

La., Bastrop—Morehouse Parish plans letting contract in abt. 6 weeks for bldg. 150 miles highway.

La., Baton Rouge—City considering paving about 100 streets. W. P. Burden, Secy. of Comn. Council.

La., Lafayette—$300,000 bonds voted for bldg. road bet. Clarenero and St. Landry Parish line in Lafayette Parish; also to pave Johnson Ave., in Lafayette, as well as 9 other roads in parish.

La., Lake Charles—City plans expdt. of about $2,000,000 for street and sidewalk paving.

La., New Orleans—City plans expending $1,000,000 for paving various streets here. For detailed information address the Mayor.

Minn., Alexandria—Douglas County voted in favor of $250,000 bond issue for road work on Hwy. 29, known as the Alexandria-Parkers Prairie Rd., near here. Vernon Thomas, Aud.

Miss., Biloxi—$90,000 voted here for street impvts. and beach protection. Jno. J. Kennedy, Mayor.

Mo., Moberly—City Council has retained Benham Engineering Co., Kansas City, Mo., as Cons. Engrs. on paving improvebents. It is planned to put thru large program of resurfacing in 1924. Plans will be worked out immediately so that prelim. details may be completed in time for actual constr. work to start in Spring. Rolla Rothwell, Mayor.

Mo., Warrenton—State Hwy. Dept. at Jefferson plans to construct 4 concrete roads in Warren County from St. Louis to Kansas City, as follows: 3.579 mi. Fed. and State Proj. 236-A, Rte 2; 4.523 mi. State and Fed. Proj. 236-C, Rte. 2; 4.374 mi. State and Fed. Proi. 236-B. Rte. 2; 4.834 mi. State and Fed. Proj. 236-D, Rte. 2. B. N. Piepmeier, Chf. Engineer.

Mont., Livingston—Petitions being circulated for paving, curbing and constructing storm sewers in residential streets. Est. cost, $200,000. Harry H. Shelver, City Clk.

Neb., Omaha—Ords. passed for Impvt. Dists. 2437, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462 2463 and 2464. Pave and curb with apsh. stone, vit. brick, vit. blk., artificial stone, macad., creo. wood blk., or asph. concrete. C. F. Bossie, City Clk.

S. C., Laurens—Laurens County plans highway and bridge impvts.; contemplates $1,000,000 bond issue. J. E. Jacobs, Vice-Chmn. of County Comn.

S. Car., Sumter—Sumter Co. will improve highways; $1,500,000 bonds voted for the improvement.

S. D., Pierre—Contracts will be let early in spring for grading and draining: F. A. F. 167, Bon Homme Co., Tyndall to Springfield, 9.8 miles, est. cost $31,663; F. A. P. 158, Clay--Turner Cos., Centerville to Vermillion, 23.5 miles, est. $108,262; F. A. 149, Spink Co., Redfield no., 25.5 miles, est. $83,-044. State Hwy. Comn., Pierre.

Tex., Anderson—$450,000 bonds voted for

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

road bldg. in Grimes Co., Rd. Dist. No. 1. R. M. West, Co. Judge.

Tex., Angleton—$350,000 bonds voted by Brazoria County for bldg. 11½ miles paved highway on Glacier-to-Gulf Rte., connecting with hard surfaced rds. in Harris Co. leading to Houston, Galveston and other ports; also joining this city with Angleton and Bay City; 4 miles of concrete and remainder of stone and shell base topped with bitum. material; lateral roads to be of conc. and bitum. material will lead to Damon and to Brazoria Co. line on each side.

Tex., Austin—Travis County will receive bids in about 30 days to grade and construct drainage structs. on St. Hwy. No. 2, Round Rock Rd., F. A. P. 409. Est. cost, $28,000. C. Leonard, Co. Engr. Geo. S. Mathews, Co Judge.

Tex, Carthage—Panola County contemplates bldg. highways east and west, north and south, through county. $225,000 bonds voted. A. D. Nelson, Co. Judge.

Tex., Dallas—City plans to expend $250,000 to $300,000 for paving 17 additional streets; Warrenite bitulithic, rock asph., Willite sheet apsh., Willite asph., conc. and vit. brick; 6-in. conc. base. Will soon receive bids. E. A. Kingsley, City Engr.

Tex., El Paso—$1,260,000 bonds voted here for road bldg. (69 miles) in El Paso County. L. A. White, Co. Engr. E. B. McClintock, Co. Judge.

Tex., Hallettsville—Lavaca County considering impvt. of 14.23 mi. State Hwy No. 2, F. A. P. 373-B. Est. cost, $165,053; Fed. aid $25,000. Secy. of Agriculture, U. S. Bureau of Public Rds., Washington, D. C., approved plans. W. B. Koether, Co. Engr., and C. L. Stairnoha, Co. Judge, Hallettsville, Tex.

Tex., Hemphill—Sabine County contemplates bldg. 5.85 mi. 16-ft. gravel road on State Hwy. No. 8, Tebo-Brooklyn Sec. Est. cost, $91,240; Fed. aid 50 per cent. W. A. French, Co. Engr., San Augustine; W. M. Davidson, County Judge, Hemphill.

Tex., Hillsboro—Hill County plans to construct 5.65 miles State Hwy., No. 2-A, Itasca Dist., gravel and bitum. top. Est. cost, $98,000. U. S. Dist. Engr., Fort Worth, approved plans. Guy W. Johnson, Engr. in charge; W. L. Wray, Co. Judge, Hillsboro, Tex.

Tex., Jacksboro—Jack County plans to construct bitum. macadam pavement on State Hwys. Nos. 25 and 26, and F. A. P. Hwy. which crosses county; $400,000 bonds voted; State and Fed. aid granted, $650,000. J. D. McComb, Co. Judge.

Tex., Jasper—Chf. Engr. U. S. Bureau of Public Roads, Washington, D. C., has approved plans for 6.06 mi. State Hwy. No. 7, bet. Jasper and Newton Co. line, Jasper Co., Fed. Aid Proj. 317-A. Est. cost, $129,146; Fed. aid, $46,620. C. P. Hunter, Co. Engr.; A. L. Hancock, Co. Judge.

Tex., Fairfield—Freestone County contemplates improving roads. Will vote Dec. 22 on $1,000,000 bonds.

Tex., Linden—Cass County plans road bldg.; may vote on $1,000,000 bonds. S. L. Henderson, Co. Judge.

Tex., Madisonville—$300,000 bonds voted in Madisonville County for road work. Road Dist. created composed of Precincts Nos. 1, 2 and 4. Plans road and highway impvts. T. Ferguson, Co. Judge.

Tex., Palestine—Anderson Co. will soon let contract to grade and construct drainage structs. on 9.7 miles 16 and 18-ft. conc. pavement on State Hwy. 19, F. A. P. 403. Est. cost $360,000. E. W. Davis, Co. Engr.; W. C Quick, Co. Judge.

Tex., Palo Pinto—Palo Pinto County will receive bids in about 60 days for 5 miles 18-ft. waterbound macadam, bitum. top road on State Hwy. No. 25, from Mineral Wells north. Approx. cost, $100,000. G. W. Courter, Co. Engr., Mineral Wells.

Tex., Sonora—Sutton County contemplates improving 37 miles Old Spanish Trail Hwy., Sonora to Kimble Co. line; grade, construct draing. structs. and gravel surface 17 miles; grade, construct draing. structs., 20.1 miles. Est. cost, $430,000. N. P. Stockton, Jr., Co. Engineer.

Wash, Olympia—Washington State Hwy. Comn. plans to construct 53 miles paving and 280 miles new rd. constr. in 1924, in addition to constr. of several brdgs. Est. cost of impvts., $5,300,000. 50 miles grading of Olympia hwy. planned. Large volume of wk. will be carried out in Eastern Wash. Gig Harbor branch of Navy Yd. Hwy. will be regraded and improved; 16-mile stretch of Lympia hwy., bet. McCleary and Elma, will be hard surfaced. Many other large projects are planned.

Wash, Olympia—Specfs. being completed for clearing entire 50 miles of right-of-way to close gap in Olympia Hwy., on west side of Olympic peninsula. It is hoped contracts can be let in January. Specfs. will be rushed to Washington, D. C., for approval of U. S. Bureau of Roads relative to use of Fed. aid and forest money. Job will be divided into 2 contracts. One will cover 22 mi., from Lunch creek on south to Kalock creek, abt. 10 mi. no. of Queets river; the other will cover northern section from Bogachiel river down to Kalock creek. State Hwy. Engr. Allen hopes and expects to have entire way cleared by next legislative session in January, 1925, when appropriations will be sought for grading and grubbing.

Wis., Elkhorn—(Walworth County) Co. Board has appropriated $5,000 for purch. of road machinery, and $433,332 voted for road construction. N. J. Peters, Comnr. Wausau (Marathon County) Co. Bd. voted $144,062 for rd. constr., $14,000 for purchase of rd. machy., including 1 12-ft. grader, patrol graders and gravel crusher, also screening plant. H. J. Vogt, Commr. Washburn (Bayfield County) Co. Bd. voted $58,470 for rd. construction and $10,000 for rd. machinery. Jno. Friberg, Commr. Medford (Taylor County) Co. Bd. voted road constr. program for 1924 amounting to $83,051 and $9,000 for rd. machinery. C. Klenhofer, Commr. Montello (Marquette Co.) Co. Bd. approp. $7,500 for purch. of rd. machinery, including crusher and truck; also $35,500 for road work. Herman Schmitz, Commr.

SEWERAGE AND SEWAGE TREATMENT

Ala., Fairfield—Exchange Club of Fairfield (J. W. Brooks, Chrmn) interested in constr. of county sewer iin Possum Valley. Est. cost, $1,000,000.

Cal., Gilroy—Plans prepared for sewage disposal plant. Est. cost, $100,000. C. E. Sloane, Santa Fe Bldg., San Francisco, Engr.

Cal., Morgan Hill—Plans prepared for sewerage sys., disposal plant, treatment plant, including Imhoff tanks, with separate sludge beds, sprinkling filter, etc. C. C. Kennedy, Call Bldg., San Francisco, Engr.

Cal., Pasadena—Board of Directors adopted resolution preparatory to calling election to vote $125,000 bonds to finance pipe line connections to sewage disposal plant.

Ont., Milton—City Council contemplates constr. of sewage disp. system. By-law will be submitted next January, and if passed work will start next year. Engineer-in-Charge, W. L. McFaul.

Ont., London—City Council contemplates sewer extensions at cost of $200,000. W. A. Near, Engr.-in-Charge.

Ga., Atlanta—City considering issuing $10,000,000 bonds for sewer construction during 1924. Wm. A. Hansell, Chf. of Construction.

Ga., Bainbridge—City plans to expend $100,000 for sewerage extensions. Work may begin first of year. O. H. Long, Engr., Moultrie, Ga.; A. B. Conger, Mayor.

Ga., Columbus—City (Walter Richards, Mgr) contemplates installing municipal sewer system to cost approx. $1,000,000, and to be laid within next 5 yrs.

Ill., Deerfield—Plans being prepared by Consoer Engineering Co., 140 S. Dearborn St., Chicago, for sewerage system and disposal plant. Est. cost, $150,000.

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Ill., Stickney—Town contemplates constructing sewerage system at cost of $200,000. Consoer Engineering Co., 140 S. Dearborn St., Chicago, Cons. Engrs.

Ky., Louisville—Commrs. of Sewerage plan to construct central relief sewer, Broadway to Main and 9th Sts.; semi-elliptical, 9-ft. diam. Est. cost, $500,000. J. B. F. Breed, 417 W. Main St., Engr.

Mich., Grand Rapids—$5,000,000 bonds voted for disposal plant, storm water relief and intercepting sewers. M. P. Adams, City San. Engr.

Mo., Carthage—City has voted $110,000 bonds for extension of sewer and bldg. sewage disposal plant. C. F. Drake, Mayor.

N. J., Riverton—Revised plans being prepared for 11,500 lin. ft. 6-15 in. vit. clay sewers, Imhoff tanks, disp. plant, pumping station, etc.; $85,000. Sherman & Sleeper, Camden, Engrs.

N. Y., Albany—City contemplates extending 2 miles Patroons Creek sewer and branches from below Russell Rd. reservoir to Central Ave. Est. cost, $125,000. F. Ravens, City Hall, Engr.

N. Y., Binghamton—City plans to construct trunk sewer and improvements Trout Brook. Est. cost, $100,000. E. H. Prentice, City Engr. City also considering constr. of general impvts. and reclamation work in Brandywine swamp at cost of $500,000.

N. C., Greensboro—City (B. Y. Ward, Clk.) authorized issuance of $50,000 bonds for extending and enlarging sewer system. $50,000 for extending and enlarging water works; $500,000 for constr. and repair of streets and $50,000 for erecting and equipping city abattoir.

Ohio, Massillon—$300,000 bonds voted for trunk sewers here.

Okla., Stroud—$53,000 bonds voted for constr. of main sewers and sewage disposal plant. Benham Engineering Co., Cons. Engrs., Kans. City, Mo.

Pa., Philadelphia—$9,000,000 bonds voted here for sewage disposal plants and $3,300,000 for constr. of sewers.

Tenn., Union City—$125,000 bonds voted here for constr. of sewerage system and elec. light plant.

WATER SUPPLY AND PURIFICATION

Ala., Birmingham—Birmingham Water Works Co., (H. K. Horner, Gen. Supt.) plans expendt. of $420,000 next year for imp,,ts: $20,000 for bldg. and completing superstruct. for 8 conc filters at Shade Mtn. plant; $45,000 for completion of piping, strainers and other betterments of the filters; 10 blocks of additional 12-in. main for Hillman Ave.; laying of 5,000 ft. 12-in. water main in E. Thomas; completion of 16-in. water main in Possum Valley Rd.; 12-in. reinforcing main on 16th St.; construction of 12-in. reinforcing main on 16th St. Company has also completed arrangements to take over Roebuck Water system.

Ont., Toronto—12 miles of 6-12 in. cast iron mains will probably be laid in Area A at $88,000 and in Area B at $170,000, York Twp. F. B. Goldike, 40 Jarvis St., Toronto, Engr.

Idaho, Lewiston—Plans announced by City Water Supt., E. G. Wagner, for installation of new filtration system at cost of $350,000, to handle 6 million gals. of water daily.

Kans., Kansas City—City plans to extend water plant; $275,000 for 25 m.g. settling basin, $160,000 for 12 miles new mains, $95,000 for 3 new pumping units. F. F. Beauchamp, Constr. Engr. Bonds voted.

Md., Baltimore—City has tentative program of proposed expendts. from $10,000,000 water loan; expending 4 million for impounding works; $250,000 for constructing new and impvts. to existing service stations; $350,000 for constructing new and enlarging present reservoirs; $400,000 for purchase of plants of remaining private water companies; $5,000,000 for distribution mains (supply, feeders and distributors). Howard N. Jackson, Pres. Board of Awards; A. Bernard Siems, Water Engr.

Mo., Kansas City—City will expend $11,000,000 for additional water supply (amt. provided under recent bond issue). 1st portion of new works to be let are in Contr. 1: A 7 ft. 6-in. conc. tunnel in rock, Contr. No. 2, branch tunnels, $25,000; A 7 ft. conc. tunnel in rock; probably 16 m.g. conc. covered reservoir later. Const. of Missouri Valley tunnel $15,000. Bids will be opened about Jan. 1, 1924, for pressure tunnels; will also install purification works, pumping stations and discharge mains. Will open machinery bids probably next spring. Fuller & Waitland, Engrs., 600 Walnut St., Kansas City.

Mo., St. Louis—Will probably take bids in February on three 66-in. cast iron pipe lines from new water plant at Howard's Bend to western city limits, about 14 miles. Altern. plan calls for two 72-in. lines. ($2,500,000. E. E. Wall, City Hall, Commr.

Mont., Missoula—City contemplates installation of new water supply system. Est. cost $900,000. Cons. Engrs., Burns & McDonell, 404 Marsh-Strong Bldg., Los Angeles, Cal.

Neb., Kearney—Contemplate following: Junking present plant; relocating new plant bet. 6th and 7th Ave.; concrete reservoir, 1,000,000 gals. capy.; three 24-in. wells with Diesel engines, each with 1,000 gals. capy. per min.; 29 additional hydrants. Est. cost about $140,000. Storm sewer west of Central Ave., starting on 31st St. to no. channel of Platte River. Burns-McConnell Engrg. Co., Kans. City, Mo., Cons. Engrs. V. B. Wheelock, City Clk.

Neb., Lincoln—Engineers have reported on possible sources of new water supply: Proj. 1—Springs at Sprague. Total est. cost $1,364,650. Proj. 2—Artesian wells at Beaver Crossing abt. 33 miles w. of Lincoln. Total est. cost $2,805,720. Proj. 3—Blue river abt. 20 mi. west of Lincoln. Total est. $215,400. Proj. 4—Platte River no. of Cedar Bluffs. Total est. $4,406,500. Proj. 5—Wells at Wahoo. Total est. $2,564,000. Proj. 6—Platte river at Ashland. Total est. $2,174,400. Projects 1, 3 and 6 considered best. Burns & McDonnell, Engrg. Co., Kansas City, Mo., Cons. Engrs. Theo. H. Berg, City Clk.

N. C., Hickory—City has authorized installation of gravity water system. Est. cost $90,000. Probable extension to nearby towns at total cost of about $2,250,000.

Ohio, Crooksville—Village contemplates constructing complete water system at cost of $400,000.

S. C., Westminster—$200,000 bonds voted for water and sewers. F. W. Cannon, Mayor.

Tex., Dallas—City (S. R. Alredge, Mayor) having survey made by J. C. Nagle and R. A. Thompson, Hydraulic Engrs., for developing water supply reservoir.

Tenn., Knoxville—W. J. Savage, T. H. Johnson, C. P. Ferris, Comm., appointed to make complete survey of water situation and make recommendations for new plant. City Mgr. has engaged The J. N. Chester Engineers, Pittsburgh, Pa., to make complete leak survey of City with view of stopping all leaks; repairs include new pump and motor for hydrate of lime mixer, also a 14-in. main from reservoir to standpipe, making available an additional 2,500,000 gals. of high pressure water daily. Will also make repairs to Worthington pump.

Vt., Morrisville—Village plans hydro-electric development, including concrete dam, power house, etc. Est. cost $150,000. C. A. Slayton, Morrisville, Engr. and Mgr.

Va., Norfolk—City Council of No. Norfolk, is considering appropriating $450,000 for developing municipal water system from Lake Drummond. May vote on bonds.

W. Va., Keyser—Council will receive bids in December or January for filtration plant in connection with water works system. $175,000 bond issue arranged for project.

BUYERS' GUIDE

Pumps.
De Laval Steam Turbine Co.
Evinrude Motor Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing Bar Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Special Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surface Heaters
Chausse Oil Burner Co.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Little Giant Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Tool Heaters, Asphalt
Chausse Oil Burner Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck
The Hug Co.

Valves.
Coldwell-Wilcox Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

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